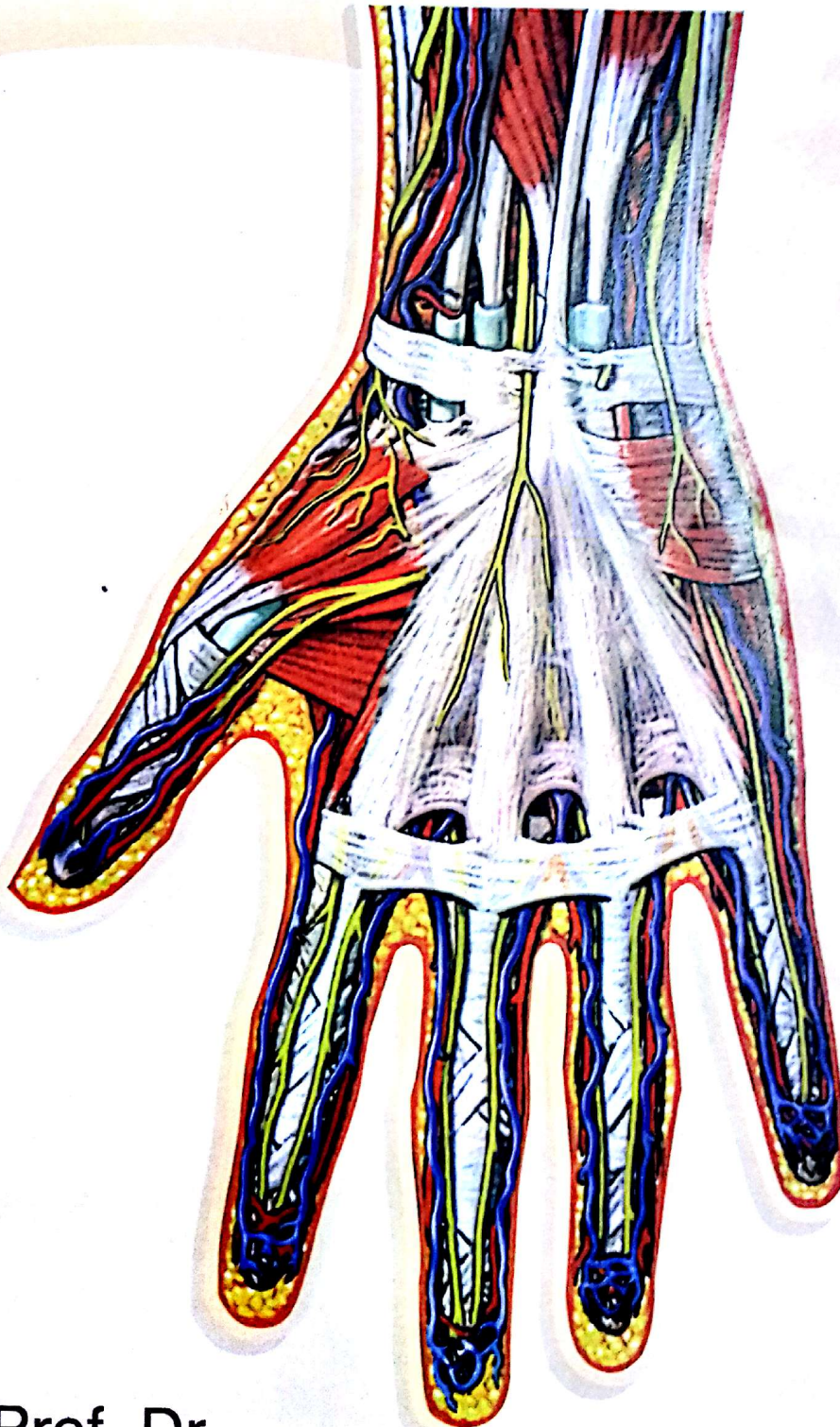
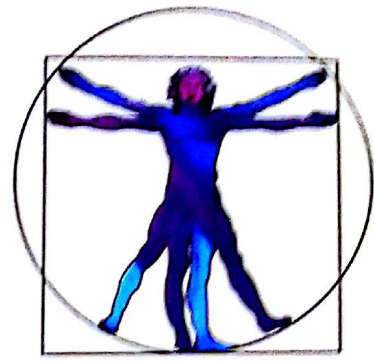


Anatomy of : **Upper Limb**

Summary & Illustrations



Prof. Dr.

Ahmed M. Kamal

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ANATOMY OF

UPPER LIMB

Summary & Illustrations

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mahmoud
tharwat



By

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رقم الإيداع ٢٠٠٨/١٣٦٥٢
الكتاب مع C.D الأصلية

BONES OF THE UPPER LIMB

- The bones of the upper limb is composed of the **shoulder girdle, arm, forearm and hand.**
- The bones of these segments are as follows:

1. Bones of the shoulder girdle:

a. **Anteriorly:** The clavicle.

b. **Posteriorly:** The scapula.

- These 2 bones surround the upper part of the chest like a belt.

- They connect upper limb with the trunk.

2. Bones of the arm: Humerus only.

3. Bones of the fore arm:

a. **Laterally:** The radius.

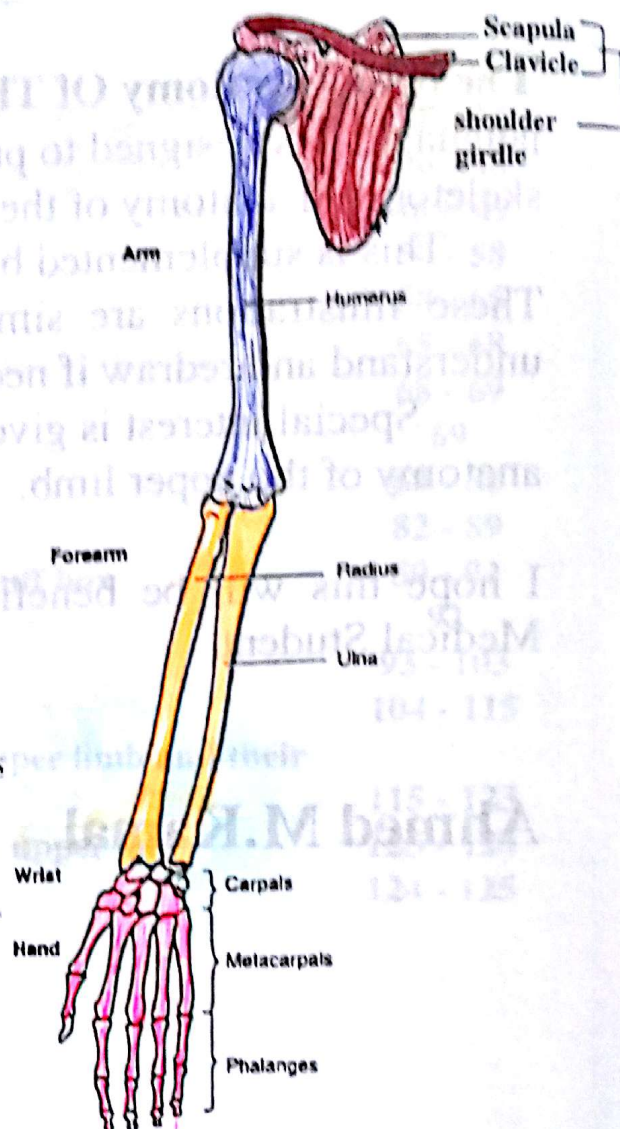
b. **Medially :** The ulna.

4. Bones of the hand:

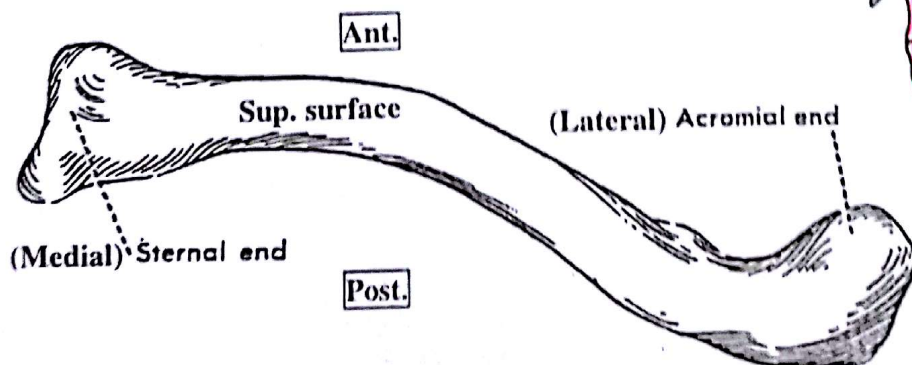
a. **Carpals:** Eight short bones.

b. **Metacarpals:** Five short long bones.

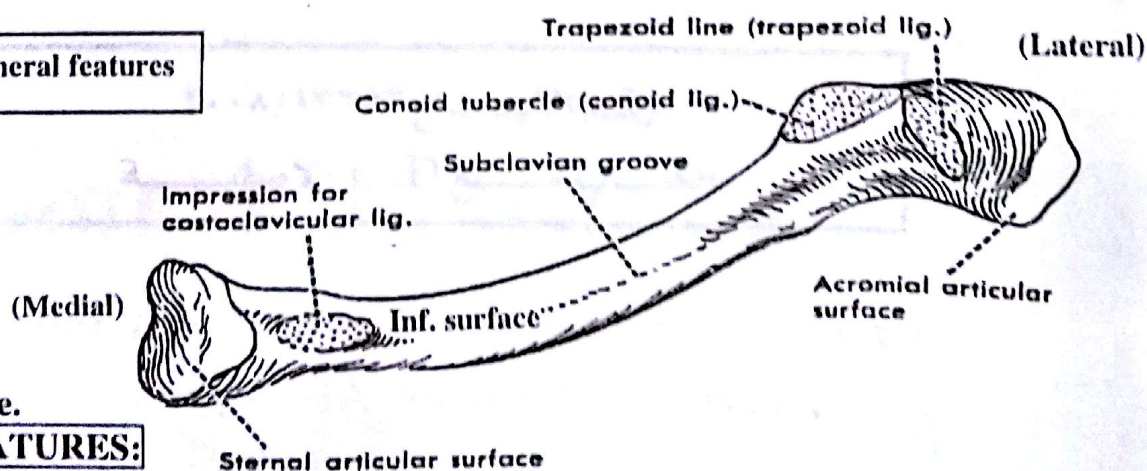
c. **Digits:** Each digit contains **three phalanges** except the thumb; it has two only.



CLAVICLE



Right clavicle - general features



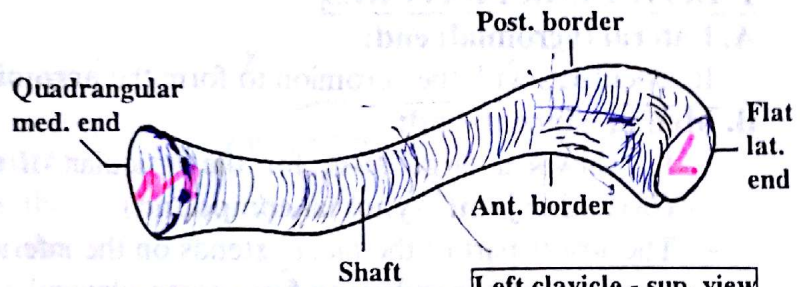
Type: Long bone.

GENERAL FEATURES:

The clavicle has **2 ends** (medial and lateral) and a **shaft** between the 2 ends.

A. The lateral (acromial) end:

Flat, and has oval articular facet which articulates with the acromion to form acromioclavicular joint.



B. The medial end: Large, rounded or quadrangular.

It has large facet which articulates with:

- The manubrium sterni to form sternoclavicular joint.
- The first costal cartilage to form costoclavicular joint.

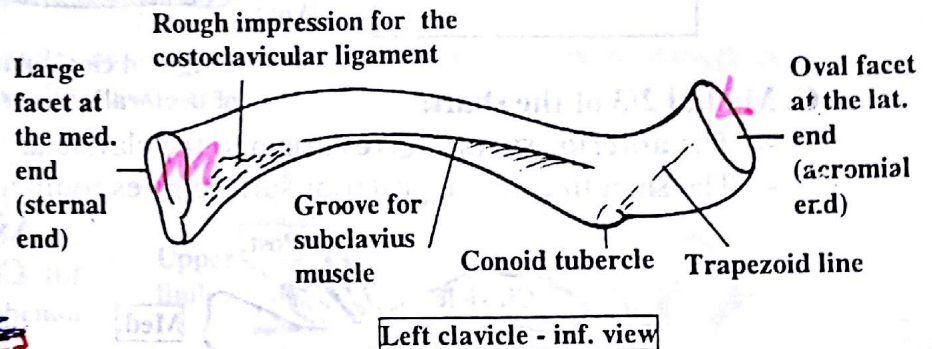


C. The shaft:

It is divided medial 2/3 and lateral 1/3.

Medial two thirds of the shaft:

Cylindrical or prismoid and convex anteriorly.



It has 4 surfaces:

- Anterior:** Convex, and slightly flattened.
- Posterior:** Smooth and concave.
- Superior:** Rough in its medial part.
- Inferior:** Marked by the following:
 - Groove for the subclavius muscle.
 - Rough impression medially for the costoclavicular ligament.
 - Nutrient foramen for the nutrient artery.



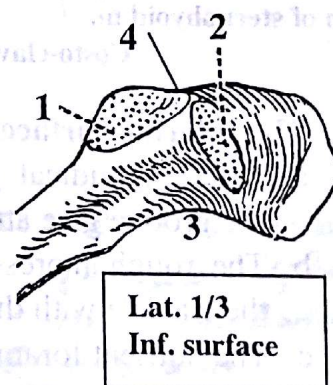
Lateral third of the shaft:

Flattened from above downwards.

- Upper (sup.) surface:** smooth except at the margin.
- Lower (inf.) surface:** roughened by a tubercle (conoid tubercle)(1) and a ridge or line (trapezoid line)(2); named after the ligament attached to them.

Anterior border: - Concave forwards(3).

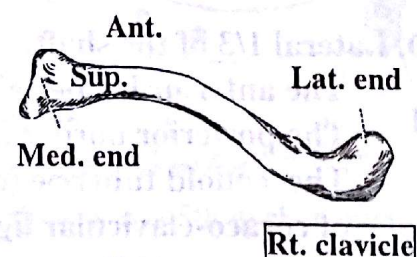
Posterior border: - Convex backwards(4).



To identify the clavicle right or left:

- Put the bone in the anatomical position with reference to your body.

- The medial end** is rounded while the lateral is flattened.
- The anterior surface** is convex medially and concave laterally.
- The superior surface** is smooth, while the inferior surface is rough.



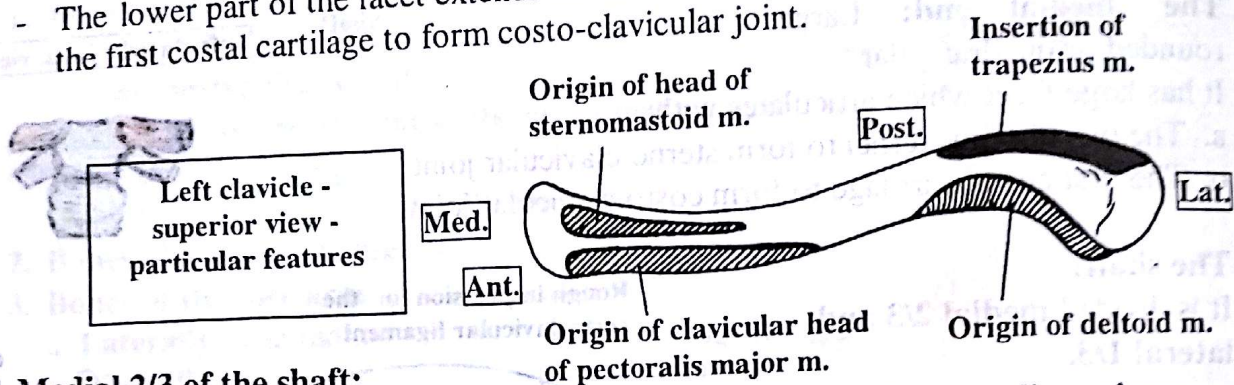
PARTICULAR FEATURES

A. Lateral (acromial) end:

It articulates with the acromion to form the **acromioclavicular joint** (synovial-plane).

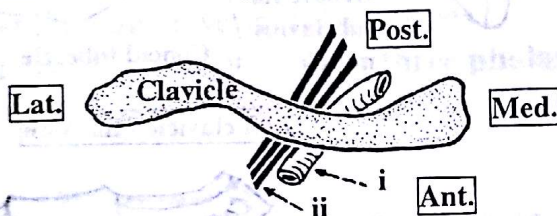
B. Medial (sternal) end:

- It shows a large facet for the articular of the manubrium to form **sterno-clavicular joint** (synovial compound).
- The lower part of the facet extends on the inferior surface for the articulation with the first costal cartilage to form **costo-clavicular joint**.

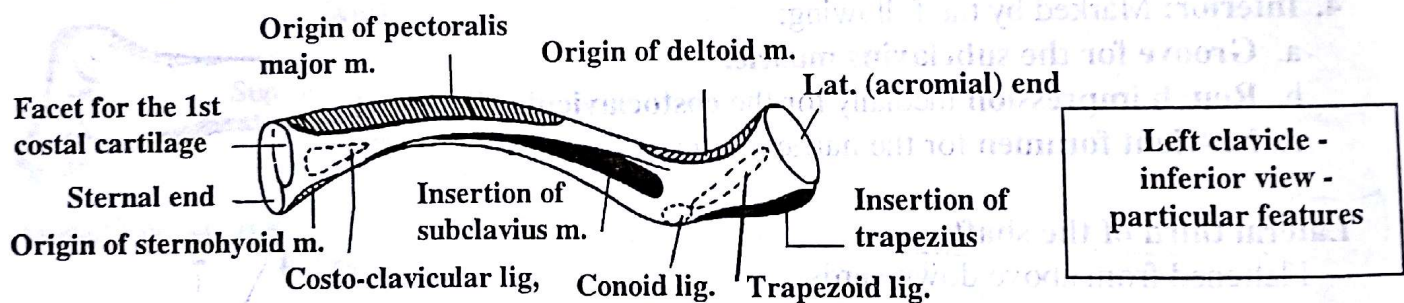


C. Medial 2/3 of the shaft:

- The **anterior surface** gives origin to the clavicular head of **pectoralis major muscle**.
- The smooth concave posterior surface gives room for the passage of:
 - Axillary artery &
 - Cords of the brachial plexus.



- The **medial 1/2** of the superior surface gives origin to the **clavicular head of sterno-mastoid muscle**.



- The inferior surface:

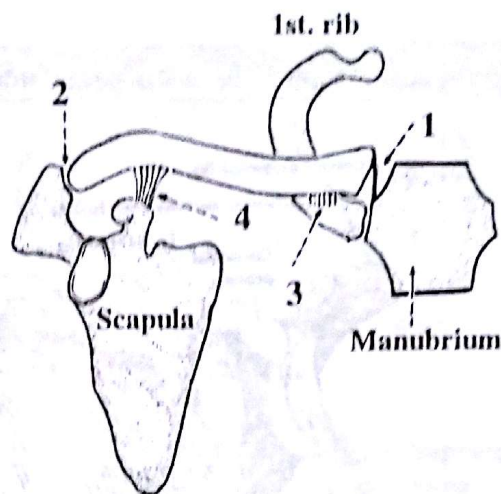
- The longitudinal groove gives insertion to **subclavius muscle**, and the lips of the groove give attachment to **clavi-pectoral fascia**.
 - The rough impression gives attachment to **costo-clavicular ligament** (connects the clavicle with the first costal cartilage).
 - The nutrient foramen transmits a **branch from the suprascapular artery**.
- The medial part of the posterior surface gives origin to the **sternohyoid muscle**.

D. Lateral 1/3 of the shaft:

- The **anterior border** gives origin to the anterior part of **deltoid muscle**.
- The **posterior border** gives insertion to the upper part of **trapezius muscle**.
- The **conoid tubercle** (on the inferior surface) gives attachment to the conoid part of **coraco-clavicular ligament**.
- The **trapezoid line** (on the inferior surface) gives attachment to the trapezoid part of **coraco-clavicular ligament**.

Articulation of the clavicle:

- Its medial end articulation with the clavicular notch of the manubrium sterni at the **sterno-clavicular joint(1)**.
- Its lateral end articulates with the acromion of the scapula at the **acromio clavicular joint(2)**.
- Its medial end is supported by the **costo-clavicular ligament(3)**.
- Its lateral end is supported by the **coraco-clavicular ligament(4)**.

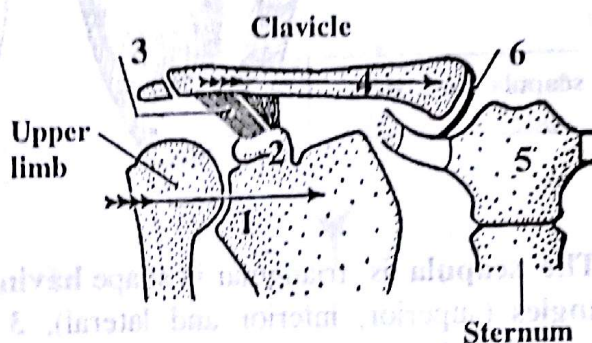


APPLIED ANATOMY

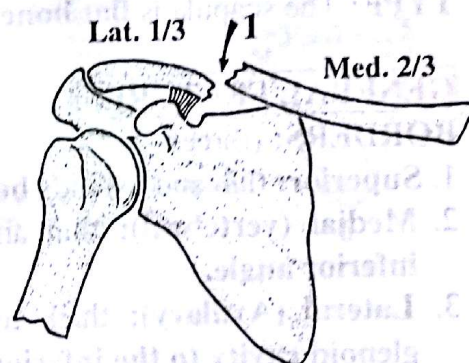


- The clavicle carry the weight of the upper limb, and transmits it to the trunk, through its articulation with the sternum (sterno-clavicular joint).

N.B.: The weight of the upper limb is transmitted through the glenoid cavity(1), coracoid process(2), coraco-clavicular ligament(3) and medial 2/3 of the clavicle(4) to reach the manubrium sterni(5) (part of the axial skeleton) through the sterno-clavicular joint(6).



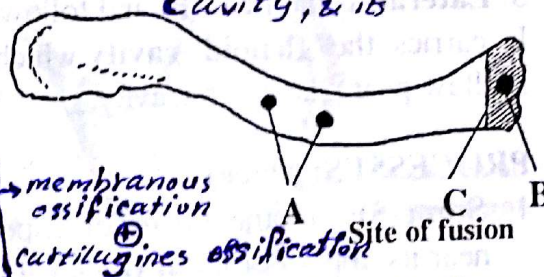
- It acts as supporting bare, allows the limb to swing away from the trunk.
- Fractures of the clavicle are common because it is:
 - Almost subcutaneous.
 - Relatively fixed.
 - Directly joined to the axial skeleton (sternum).
- Common site of fracture(1):** the junction between the lateral 1/3 and medial 2/3 of the bone because it is:
 - Thinnest part of the bone.
 - Junction between two different curves in the bone.
 - Junction between two parts different in cross-section in the bone.
 - Weakened by the groove for the subclavius muscle.
 - Weakened by the nutrient foramen.
- Common cause of fracture:** a fall on the outstretched hand.
- Deformity resulting:** The lateral fragment will be depressed by the weight of the limb and adducted by the large adductor muscles. The medial fragment will be raised by the neck muscles.
- Injury may result to the related vessels or nerves.



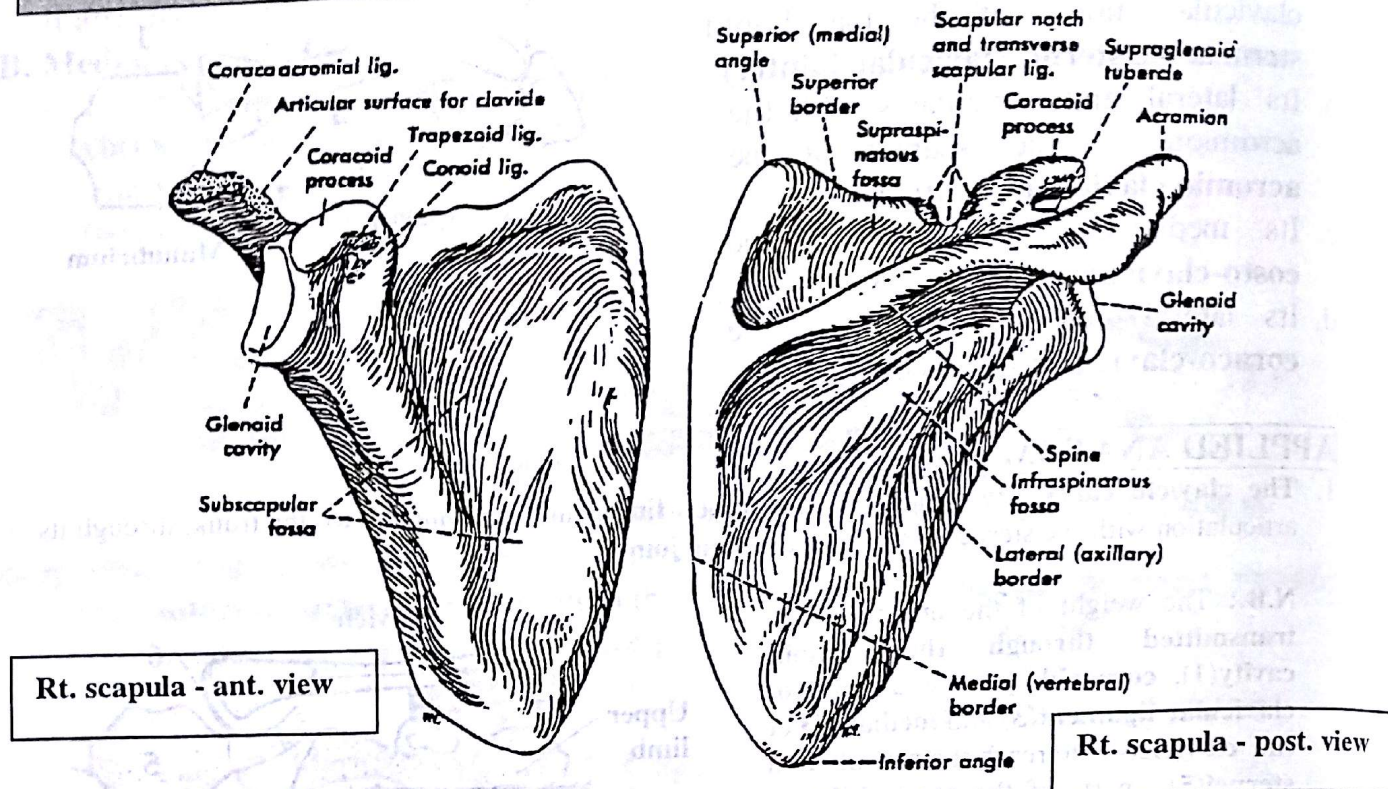
OSSIFICATION:



- It is the first bone in the body to be ossified.
- In spite of it is long bone, its shaft ossifies in 2 } *membranous ossification*
membrane and not in cartilage from primary centers, however its medial end ossifies in cartilage from one secondary center. } *cartilagines ossification*
- The primary centers(A):** Two centers in the middle of the shaft appear at 5th week of intra uterine life. They fuse rapidly.
- The secondary center(B):** One in the sternal end; appears at 17 years of age and fuses with the shaft(C) at 22 years of age.



SCAPULA



The **scapula** is triangular in shape **having 3 borders** (superior, medial and lateral), **3 angles** (superior, inferior and lateral), **3 processes** (spine, acromion and coracoid process) and **2 surfaces** (anterior and posterior).

TYPE: The scapula is **flat bone**.

GENERAL FEATURES:

BORDERS: (three)

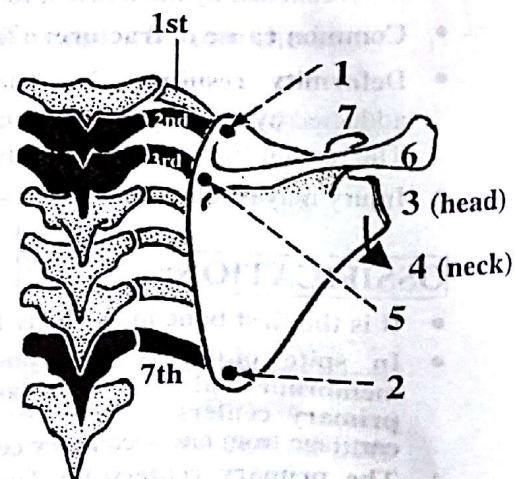
1. **Superior:** thin and extends **between the superior and lateral angles**.
2. **Medial (vertebral):** thin and long. It extends **from the superior angle to the inferior angle**.
3. **Lateral (Axillary):** thick to support the abducted arm. It extends **between the glenoid cavity to the inferior angle**.

ANGLES: (three)

1. **Superior(1):** at the level of the **2nd rib**.
2. **Inferior(2):** at the level of the **7th rib**.
3. **Lateral:** is the **head(3)** and followed by the **neck(4)**. It carries the **glenoid cavity** which is a shallow pear shaped concavity.

PROCESSES: (three)

1. **Spine(5):** on the posterior aspect of the bone near its upper border **at the level of the 3rd rib**.
2. **Acromion(6):** It is a lateral extension from the spine.
3. **Coracoid(7):** It projects from the anterior aspect its upper surface shows: conoid tubercle and trapezoid ridge.

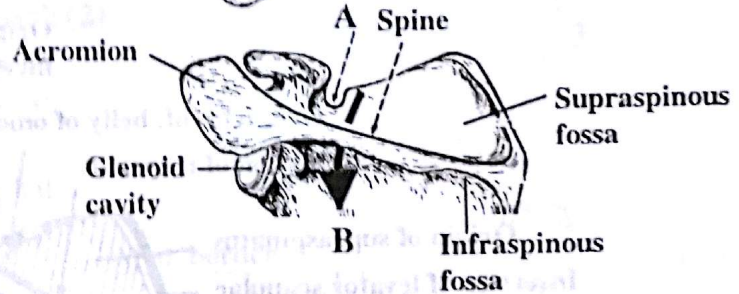
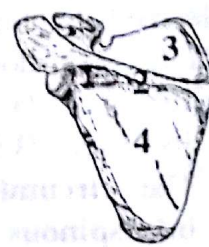


SURFACES:

1. **Anterior surface:** It is concave with faint ridges and is called **subscapular fossa(1)**.
2. **Posterior surface:** It is marked by the **spine(2)** of the scapula which divides the surface into the **supraspinous(3) (supraspinatus) fossa** (above) and **infraspinous(4) (infraspinatus) fossa** (below).

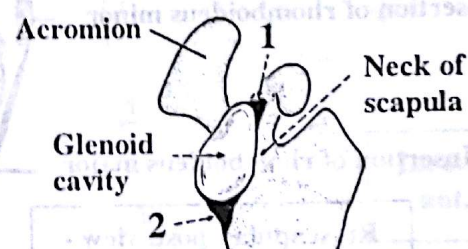
Ant. surface

Post. surface



NOTCHES: (Two)

1. **Suprascapular(A):** on the upper border.
2. **Spinoglenoid(B):** between the spine and the glenoid cavity.



TUBERCLES: (Two)

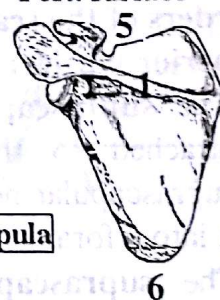
1. **Supraglenoid(1):** Above the glenoid cavity.
2. **Infraglenoid(2):** Below the glenoid cavity.

To identify the scapula right or left:

1. **Spine(1):** posterior and near the upper border.
2. The anterior surface (**subscapular fossa**)(2) is slightly concave and is marked in its upper part by the **coracoid process(3)**.
3. **Glenoid cavity(4):** lateral.
4. The upper border has the **suprascapular notch(5)**.
5. The inferior part (**angle**) of the bone is the **apex(6)** of the triangle.

Ant. surface

Post. surface

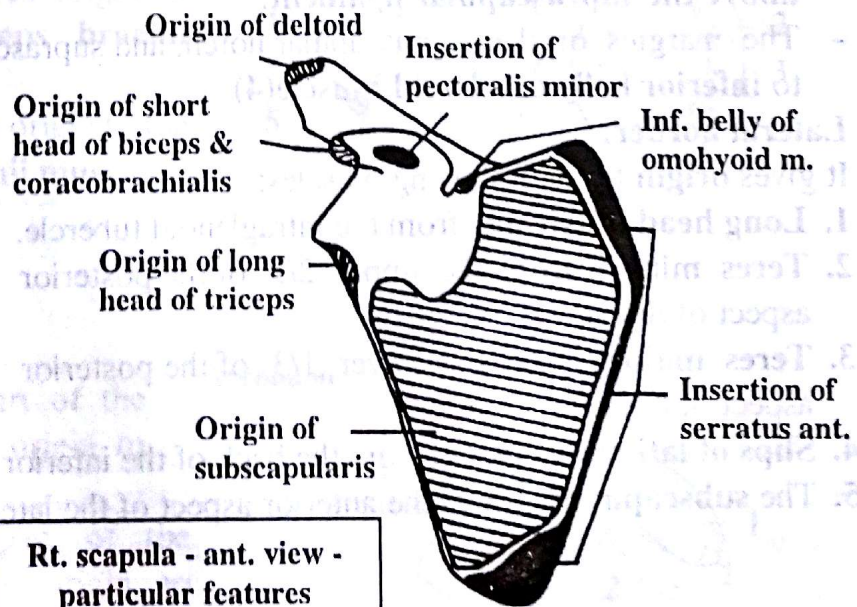


Lt. scapula

PARTICULAR FEATURES

A. Surfaces of the scapula:

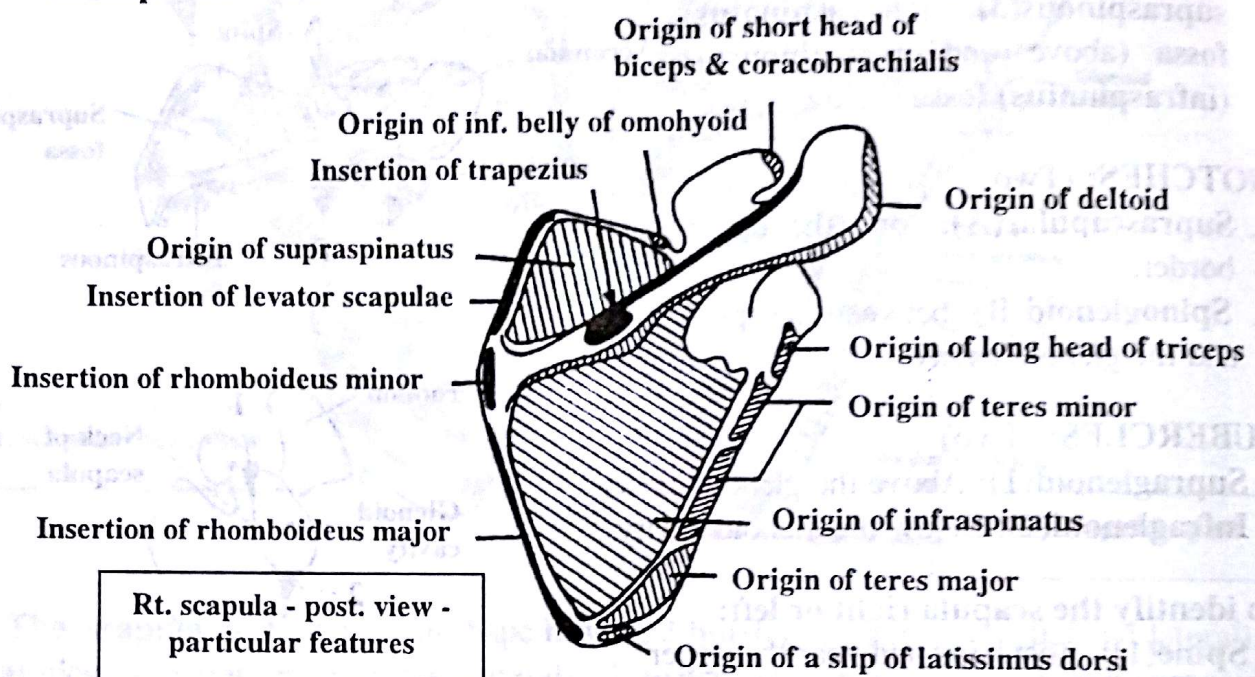
1. **Anterior (costal) surface:** Its medial 2/3 give origin to **subscapularis muscle**.



Rt. scapula - ant. view - particular features

2. Posterior surface:

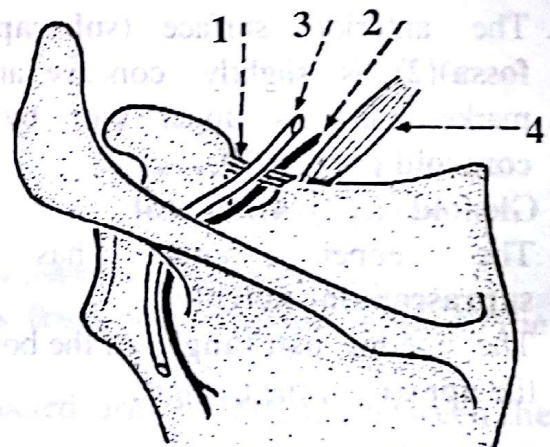
- The medial 2/3 of the supraspinous fossa give origin to **supraspinatus muscle**.
- The medial 2/3 of the infraspinous fossa give origin to **infraspinatus muscle**.
- The flat strip along the lateral border:
 - a. Its upper 2/3 give origin to **teres minor muscle**.
 - b. Its lower 1/3 is oval and gives origin to **teres major muscle**.
 - c. The **circumflex scapular artery** passes through the groove to reach the **infraspinous fossa**.



B. Borders of the scapula:

1. Superior border:

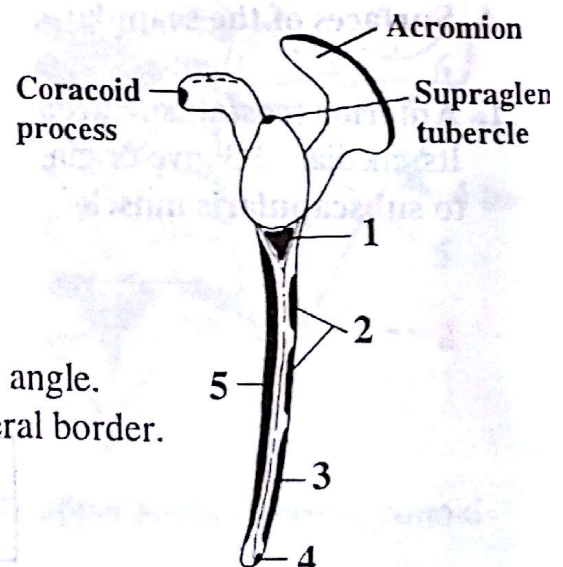
- The **suprascapular ligament(1)** is attached to the margins of the suprascapular notch and transforms it into a foramen.
- The **suprascapular nerve(2)** passes through the suprascapular foramen.
- The **suprascapular vessels(3)** pass above the suprascapular ligament.
- The margins of the suprascapular notch, and suprascapular ligament give origin to **inferior belly omohyoid muscle(4)**.



2. Lateral border:

It gives origin to the following muscles:

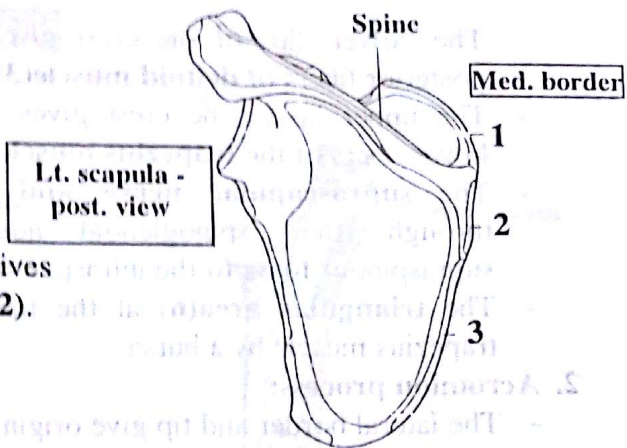
1. **Long head of triceps:** from the infraglenoid tubercle.
2. **Teres minor:** from the upper 2/3 of the posterior aspect of the lateral border.
3. **Teres major:** from the lower 1/3 of the posterior aspect of the lateral border.
4. **Slips of latissimus dorsi:** from the back of the inferior angle.
5. The **subscapularis:** from the anterior aspect of the lateral border.



3. Medial border:

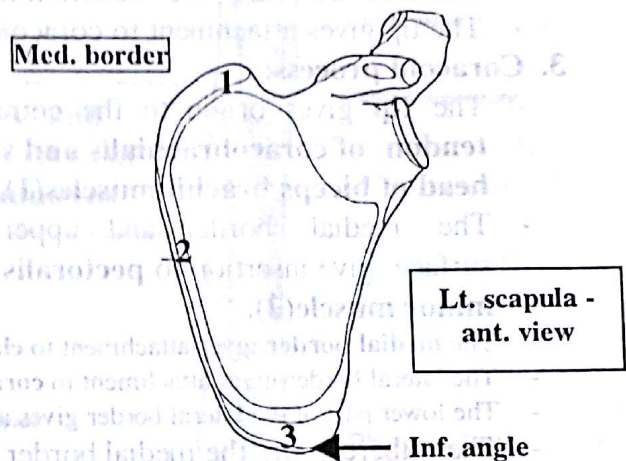
a. **Posterior surface of the medial border:** gives insertion to the following muscles:

- The part from the superior angle to the root of the spine gives insertion to **levator scapulae muscle(1)**.
- The part opposite the root of the spine gives insertion to **rhomboideus minor muscle(2)**.
- The part from the root of the spine to the inferior angle gives insertion to **rhomboideus major muscle(3)**.



b. **Anterior (costal) surface of the medial border:** gives insertion to the **serratus anterior muscle**.

- The **first digitation(1)** is inserted into the upper part close to the **superior angle**.
- The **2nd and 3rd digitations(2)** are inserted into the rest of the **anterior surface of the medial border**.



N.B.: The last 5 digitations(3) of **serratus anterior** are inserted into the **anterior surface of the inferior angle**.

C. Angles of the scapula:

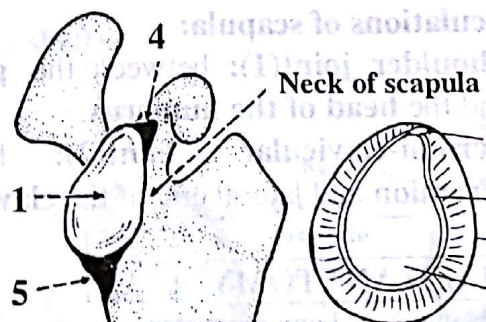
1. Inferior angle:

- Its **anterior surface** gives insertion to the lower 5 digitations of **serratus anterior muscle**.
- Its **posterior surface** gives origin to some fibers of **latissimus dorsi muscle(A)**.



2. Lateral angle:

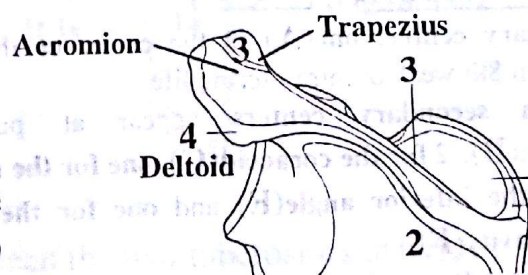
- The margins of the **glenoid cavity(1)** give attachment to the **glenoid labrum(2)**, and the **capsule of the shoulder joint(3)**.
- The **supraglenoid tubercle** gives origin to the **long head of the biceps brachii muscle(4) (intracapsular)**.
- The **infraglenoid tubercle** gives origin to the **long head of the triceps brachii muscle(5) (extracapsular)**.



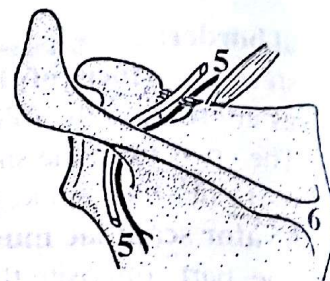
D. Processes of the scapula:

1. Spine:

- The upper surface forms part of the **supraspinous fossa** and gives origin to **supraspinatus muscle(1)**.
- The lower surface forms part of the **infraspinous fossa** and gives origin to **infraspinatus muscle(2)**.



- The lower lip of the crest gives origin to the posterior fibers of **deltoid muscle(3)**.
- The upper lip of the crest gives insertion to the lower fibers of the **trapezius muscle(4)**.
- The **suprascapular nerve and vessels(5)** pass through the spinoglenoid notch from the supraspinous fossa to the infraspinous fossa.
- The **triangular area(6)** at the medial end of the spine is separated from the trapezius muscle by a bursa.

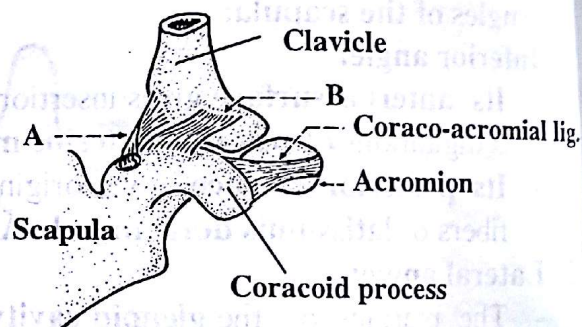
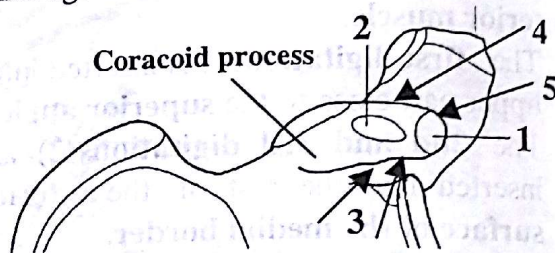


2. Acromion process:

- The lateral border and tip give origin to the middle part of **deltoid muscle**.
- The medial border gives insertion to the middle part of **trapezius muscle**.
- The tip gives attachment to coracoacromial ligament.

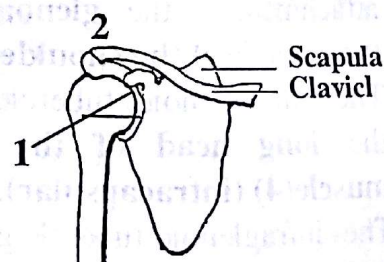
3. Coracoid process:

- The **tip** gives origin to the **common tendon of coracobrachialis and short head of biceps brachii muscles(1)**.
- The medial border and upper surface give insertion to **pectoralis minor muscle(2)**.
- The medial border gives attachment to **clavipectoral fascia(3)**.
- The lateral border gives attachment to **coraco-acromial ligament(4)**.
- The lower part of the lateral border gives attachment to **coraco-humeral ligament(5)**.
- The tubercle on the medial border gives attachment to the **conoid part(A) of coraco-clavicular ligament**.
- The superior surface gives attachment to the **trapezoid part(B) of coraco-clavicular ligament**.



Articulations of scapula:

1. **Shoulder joint(1)**: between the **glenoid cavity** and the **head of the humerus**.
2. **Acromi-clavicular joint(2)**: between the **acromion** and lateral end of the **clavicle**.



APPLIED ANATOMY



2. Subcutaneous bony prominences:

- a. The **crest of the spine**: posteriorly.
- b. The **top of the acromion**: superiorly.
- c. The **tip of the coracoid**: deeply anteriorly.

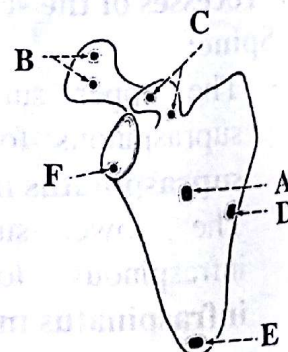
OSSIFICATION:



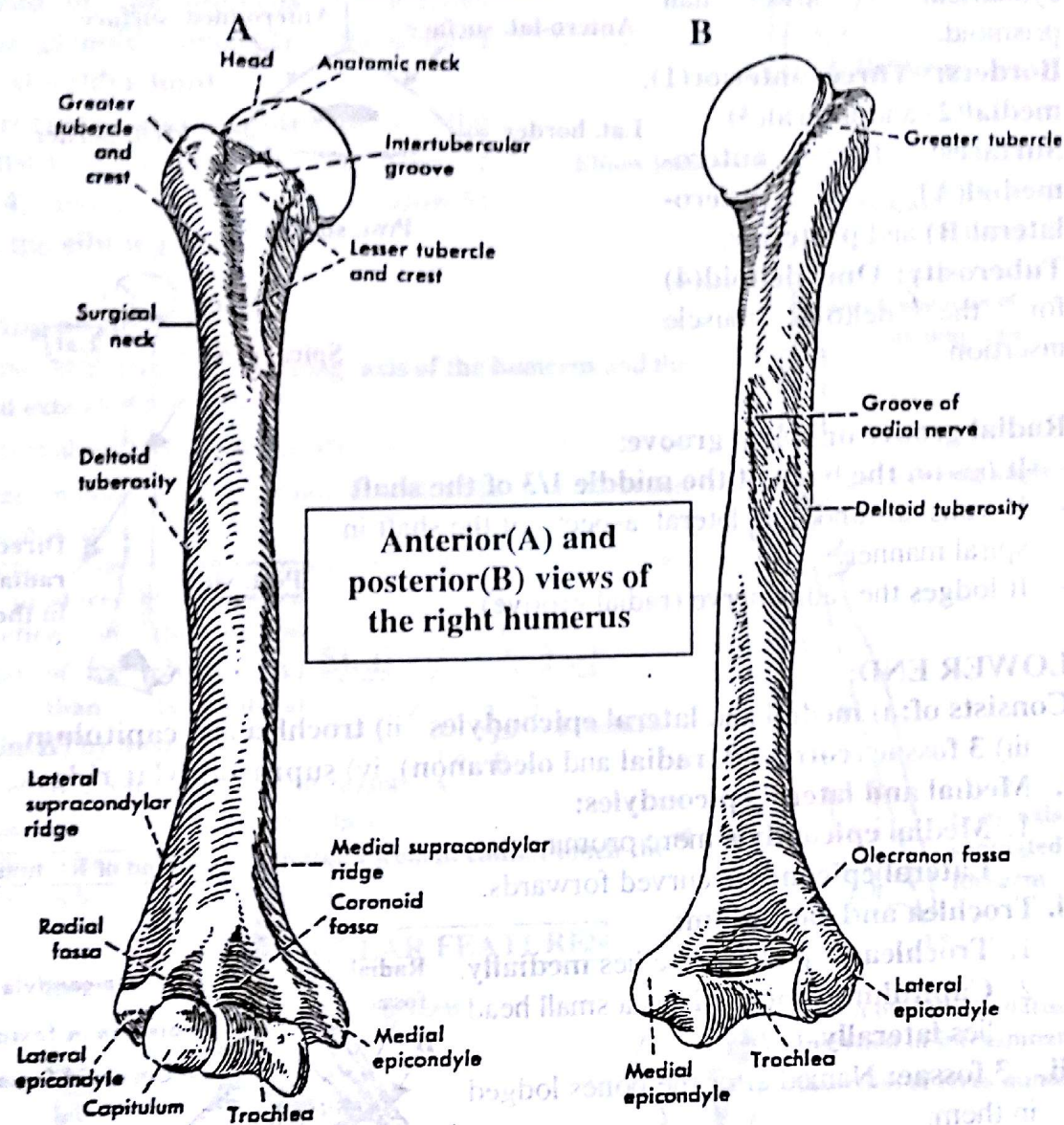
Primary center: one(A) in the center of the body, appears in 8th week of intra-uterine life.

Seven secondary centers appear at puberty: 2 for the **acromion(B)**, 2 for the **coracoid(C)**, one for the **medial border(D)**, one for the **inferior angle(E)** and one for the **lower part of the glenoid cavity(F)**.

The secondary centers unit with the bone to form a complete scapula by 20 years.



HUMERUS



TYPE: Long bone has (upper end, lower end and a shaft)

GENERAL FEATURES:

UPPER END:

Carries a head, 2 necks & 2 tubercles.

The Head: Less than half a sphere.

It is directed: upwards, backwards and medially.

Anatomical neck: is the constriction that immediately follows the head.

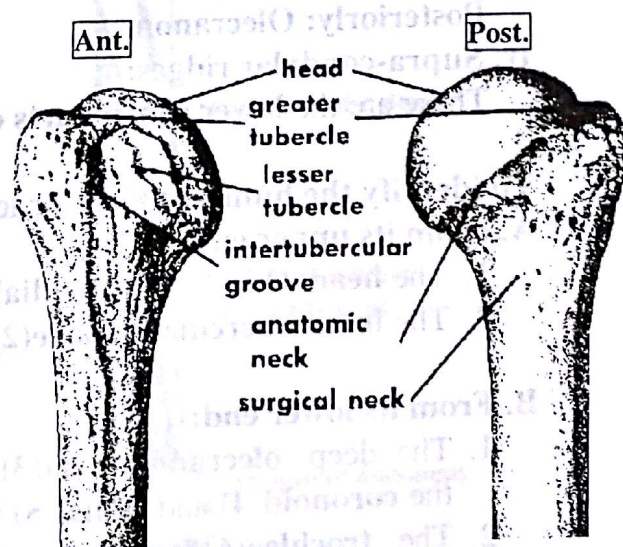
Surgical neck: is the constriction that follows the upper end as a whole. It is so called because it is liable to fractures.

Tubercles:

a. **Lesser:** small and anterior.

b. **Greater:** large and lateral.

c. **Intertubercular bicipital groove:** lies between the two tuberosities anteriorly.

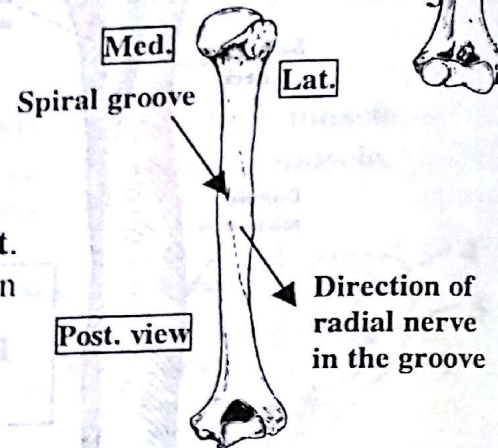
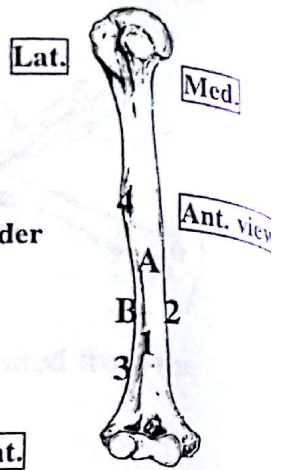
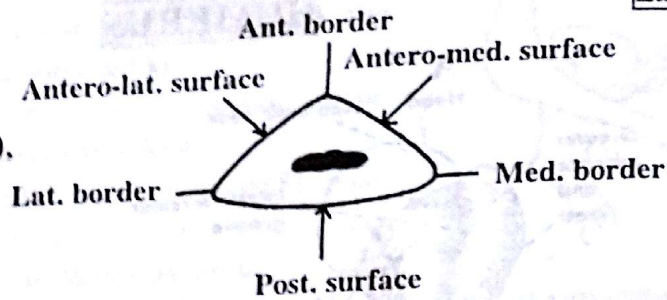


SHAFT: Upper half cylindrical - lower half prismoid.

Borders: Three: anterior(1), medial(2) and lateral(3).

Surfaces: Three: antero-medial(A), antero-lateral(B) and posterior.

Tuberosity: One: deltoid(4) for the deltoid muscle insertion.



Radial groove or spiral groove:

- It lies on the back of the middle 1/3 of the shaft.
- It runs around the lateral aspect of the shaft in spiral manner.
- It lodges the radial nerve (radial groove).

LOWER END:

Consists of: i) medial and lateral epicondyles. ii) trochlea and capitulum. iii) 3 fossae (coronoid, radial and olecranon). iv) supracondylar ridges.

i. Medial and lateral epicondyles:

1. Medial epicondyle more prominent.
2. Lateral epicondyle curved forwards.

ii. Trochlea and capitulum:

1. Trochlea: is pulley-like lies medially.
2. Capitulum: rounded as a small head lies laterally.

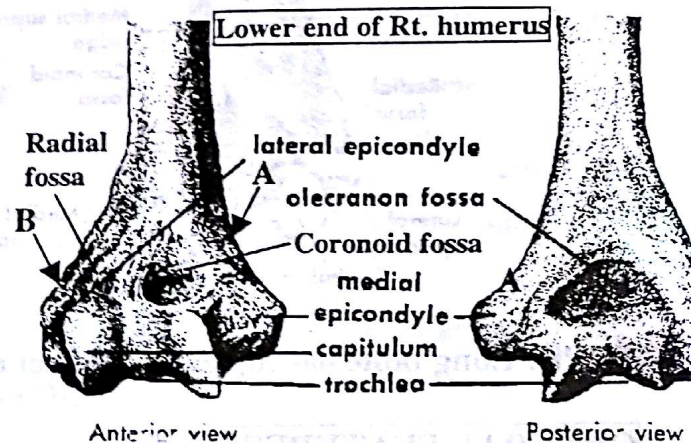
iii. 3 fossae: Named after the bones lodged in them:

Anteriorly: Radial (laterally) and coronoid (medially).

Posteriorly: Olecranon.

iv. Supra-condylar ridges:

These are the lower sharp parts of the medial(A) and lateral(B) borders of the shaft.



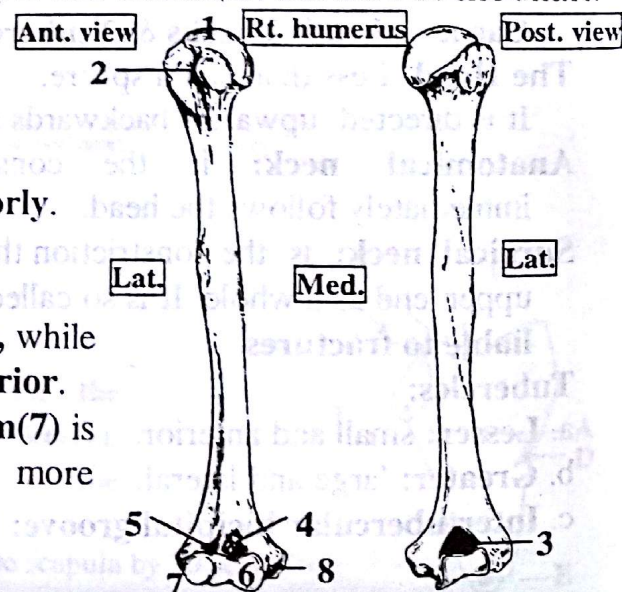
To identify the humerus right or left:

A. From its upper end:

1. The head(1) is directed medially.
2. The intertubercular groove(2) faces anteriorly.

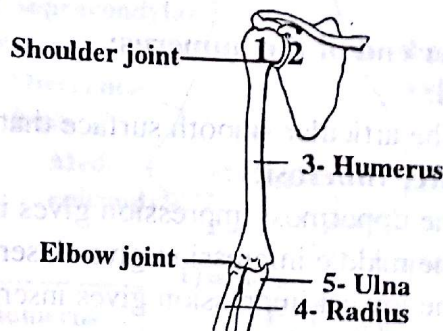
B. From its lower end:

1. The deep olecranon fossa(3) lies posterior, while the coronoid(4) and radial(5) fossae lie anterior.
2. The trochlea(6) is medial and the capitulum(7) is lateral and the medial epicondyle is more projecting than the lateral epicondyle.



Articulations of the humerus:

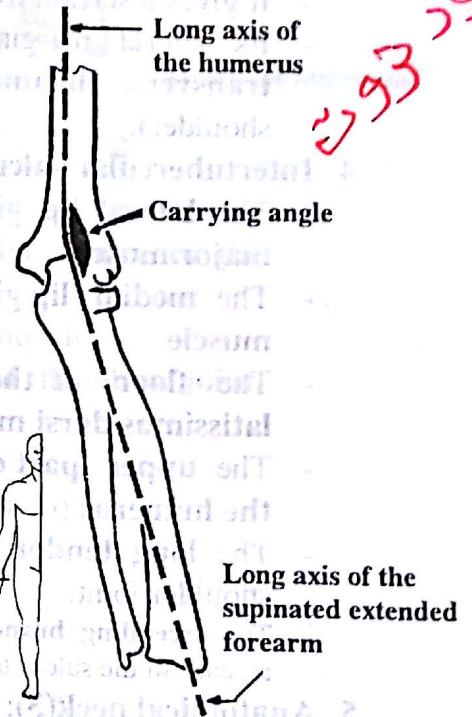
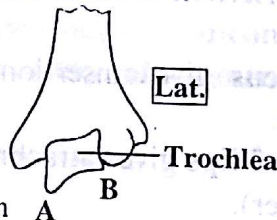
1. The head of the humerus(1) articulates with the **glenoid cavity(2)** of the scapula to form **shoulder joint**.
2. The **trochlea and capitulum** of the humerus(3) articulate with the head of **radius(4)** and trochlear notch of **ulna(5)** to form the **elbow joint**.



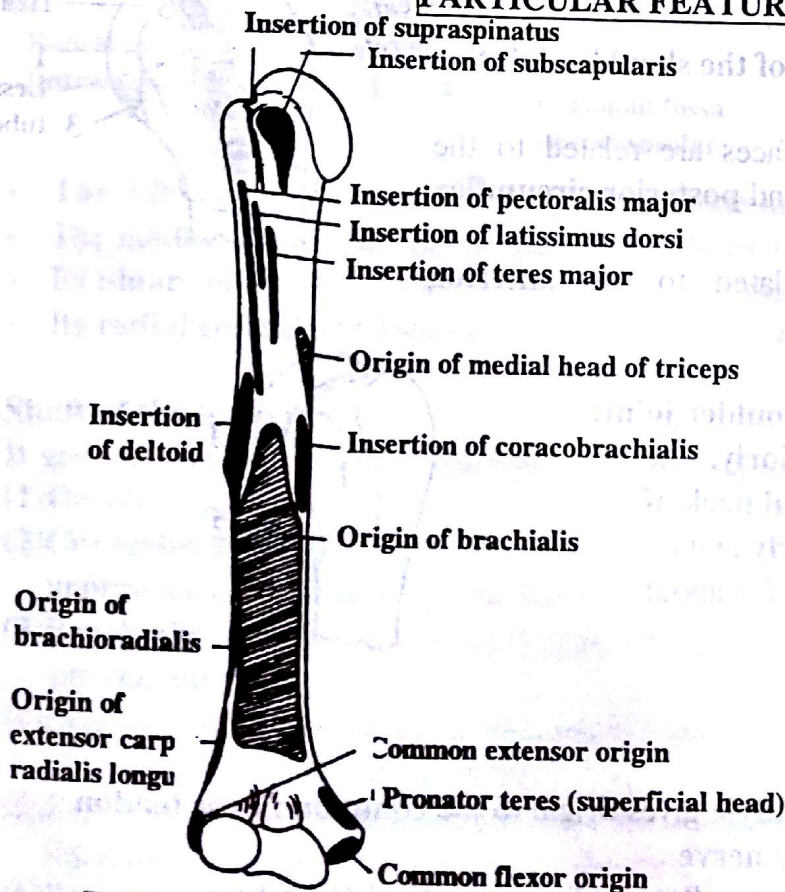
The carrying angle:



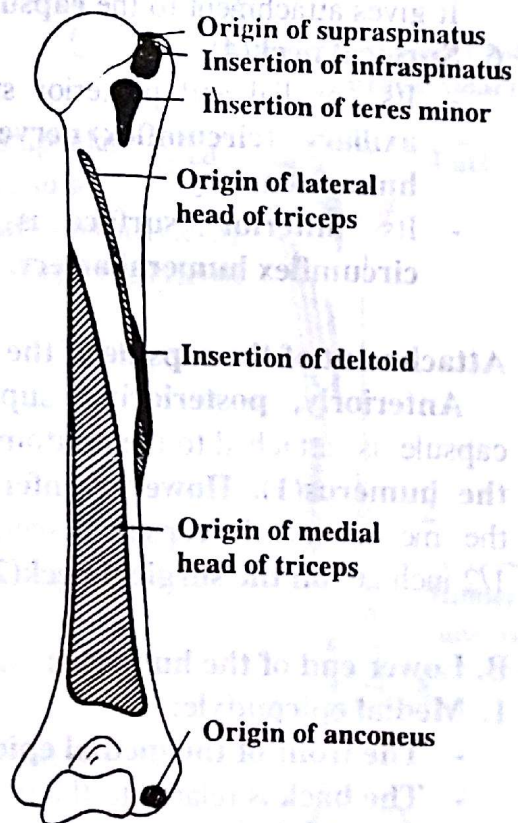
- This is the angle between the **long axis of the humerus** and the **supinated extended forearm**.
- This angle is about 165° (open lateral).
- It is larger in males than in females, in adults than in children and in man than in apes.
 - This angle disappears in pronation and inflexion of the forearm.
 - It is produced by downward projection of the medial margin of the trochlea (A) more than its lateral margin (B) by 6 mm.



PARTICULAR FEATURES



Rt. humerus - ant. view



Rt. humerus - post. view

A. Upper end of the humerus:

1. Heads:

Head:
It is the articular smooth surface that enters in the formation of shoulder joint.

2. **Greater tuberosity:**

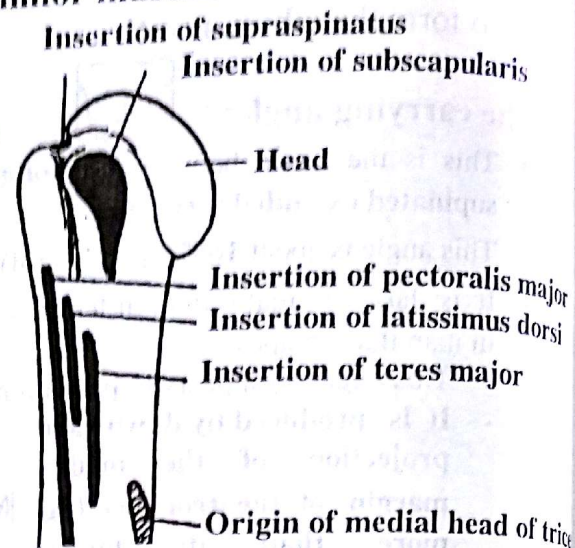
- Greater tuberosity:**
- The uppermost impression gives insertion to **supraspinatus muscle**.
 - The middle impression gives insertion to **infraspinatus muscle**.
 - The lowest impression gives insertion to **teres minor muscle**.
- Insertion of supraspinatus muscle:**

3. Lesser tuberosity:

- It gives insertion to **subscapularis muscle**.
- Its lateral margin gives attachment to the **transverse ligament of the humerus** (or shoulder).

4. Intertubercular sulcus (or bicipital groove):

- The lateral lip gives insertion to **pectoralis major** muscle.
 - The medial lip gives insertion to **teres major** muscle.
 - The floor of the sulcus gives insertion to **latissimus dorsi** muscle.
 - The upper part of the 2 lips gives attachment to the **transverse ligament(1)** of the humerus (or shoulder).
 - The long tendon of **biceps(2)** brachii muscle descends in the sulcus, from the shoulder joint.
 - The ascending branch of **anterior circumflex humeral artery** ascends in the sulcus to reach the shoulder joint.
-
- Insertion of latissimus d
Insertion of teres major
Origin of medial head o
-
- 3

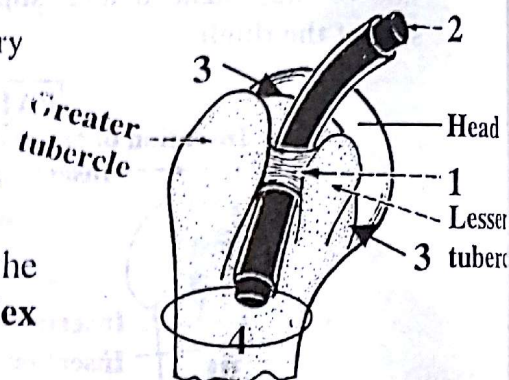


5. Anatomical neck(3):

It gives attachment to the capsule of the shoulder joint.

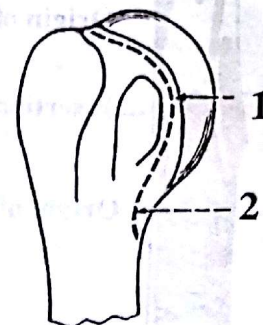
6. Surgical neck(4):

- Its medial and posterior surfaces are related to the axillary (circumflex) nerve, and posterior circumflex humeral artery.
- Its anterior surface is related to the anterior circumflex humeral artery.



Attachment of the capsule of the shoulder joint:

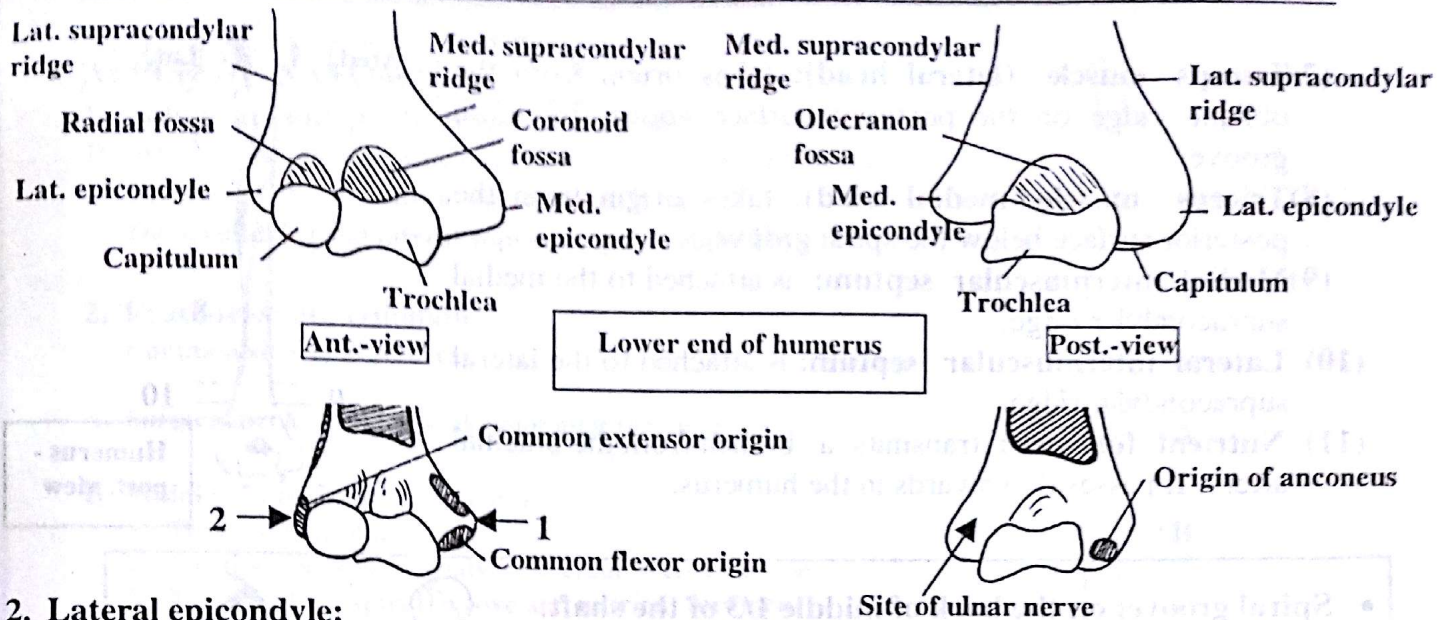
Anteriorly, posteriorly & superiorly. The capsule is attached to the anatomical neck of the humerus(1). However inferiorly and on the medial side, the capsule descends for about 1/2 inch i.e. on the surgical neck(2).



B. Lower end of the humerus:

1. Medial epicondyle:

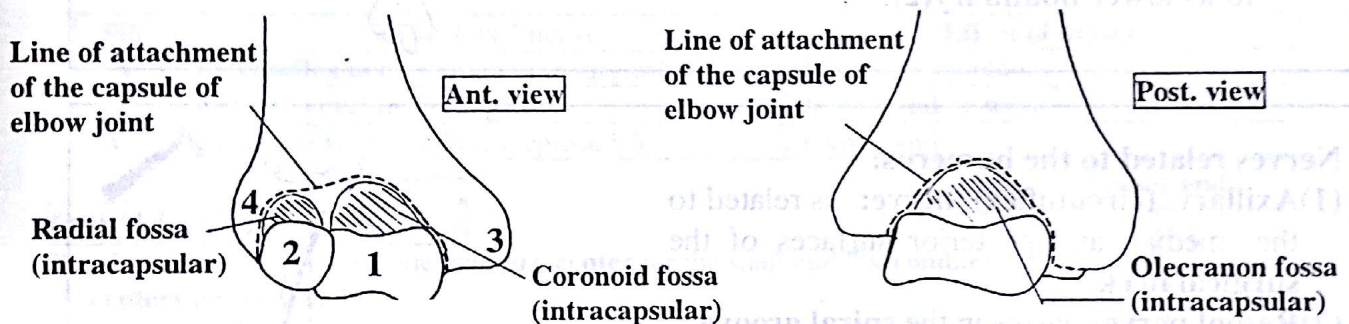
- The front of the medial epicondyle gives origin to the common flexor tendon.
- The back is related to the ulnar nerve.
- The tip gives attachment to ulnar collateral ligament(1) of the elbow.



2. Lateral epicondyle:

- The front and lateral surface of the lateral epicondyle give origin to the common extensor tendon.
- The back of the lateral epicondyle gives origin to anconeus muscle.
- The tip gives attachment to the radial collateral ligament(2) of the elbow joint.

N.B.: Attachment of the capsule of elbow joint:

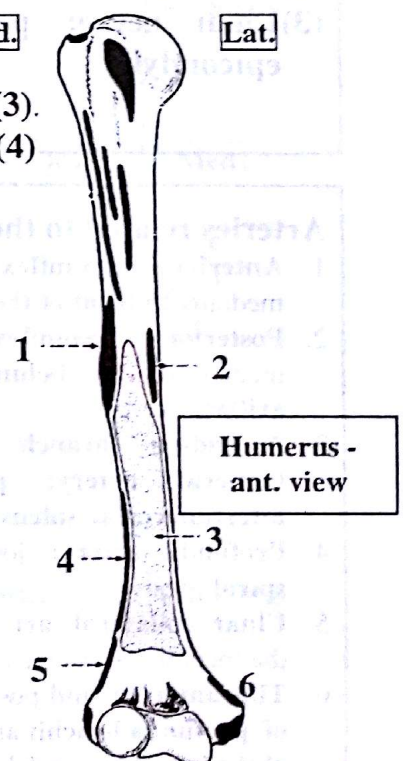


- The 3 fossae + trochlea(1) & capitulum(2) are intracapsular.
- The medial(3) and lateral epicondyles(4) are extracapsular.
- Its ulnar collateral ligament is attached to the medial epicondyle(3).
- Its radial collateral ligament is attached to the lateral epicondyle(4).

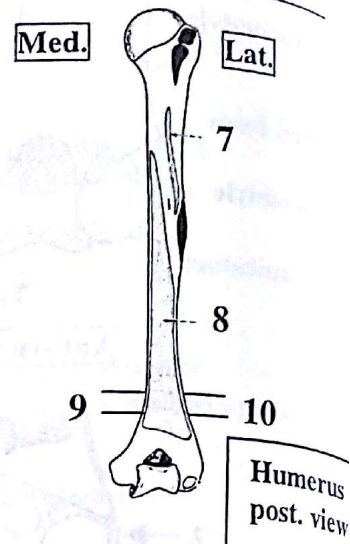
C. Shaft of the humerus:

It gives attachment to the following muscles and ligaments:

- (1) **Deltoid muscle:** is inserted into the deltoid tuberosity.
- (2) **Coracobrachialis muscle:** is inserted into the rough impression on the middle of the medial border.
- (3) **Brachialis muscle:** takes origin from the lower 1/2 of the anterior surface.
- (4) **Brachioradialis muscle:** takes origin from the upper 2/3 of the lateral supracondylar ridge.
- (5) **Extensor carpi radialis longus muscle:** takes origin from the lower 1/3 of the lateral supracondylar ridge.
- (6) **Pronator teres muscle (superficial or humeral head):** takes origin from the lower part of the medial supracondylar ridge.



- (7) **Triceps muscle (lateral head)**: takes origin from the oblique ridge on the posterior surface above the spiral groove.
- (8) **Triceps muscle (medial head)**: takes origin from the posterior surface below the spiral groove.
- (9) **Medial intermuscular septum**: is attached to the medial supracondylar ridge.
- (10) **Lateral intermuscular septum**: is attached to the lateral supracondylar ridge.
- (11) **Nutrient foramen**: transmits a branch from the brachial artery. It passes downwards in the humerus.



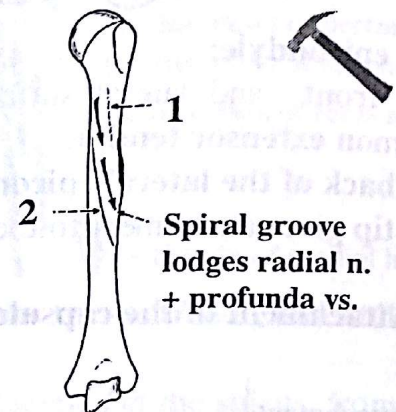
- **Spiral groove: on the back of middle 1/3 of the shaft:**

It lodges:

i) **Radial nerve.**

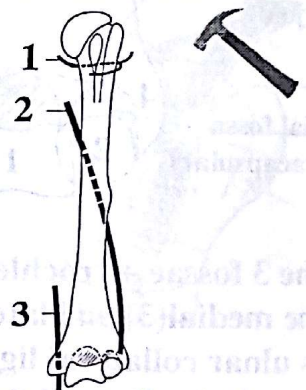
ii) **Profunda brachii vessels.**

- The **lateral head of triceps** is attached to the **upper boundary of the groove(1)**.
- The **medial head of triceps** is attached to its **lower boundary(2)**.



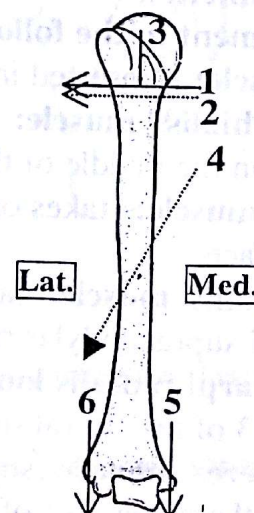
Nerves related to the humerus:

- (1) **Axillary (circumflex) nerve**: is related to the medial and posterior surfaces of the surgical neck.
- (2) **Radial nerve**: passes in the **spiral groove**.
- (3) **Ulnar nerve**: passes behind the **medial epicondyle**.



Arteries related to the humerus:

1. **Anterior circumflex humeral artery**: passes medially in front of the surgical neck.
2. **Posterior circumflex humeral artery**: passes medial to then behind the surgical neck (joint axillary nerve).
3. **Ascending branch of anterior circumflex humeral artery**: passes upwards in the intertubercular sulcus.
4. **Profunda artery**: joins the radial nerve in the spiral groove.
5. **Ulnar collateral arteries**: in front & at the back of the medial epicondyle (joint the ulnar nerve).
6. **The anterior and posterior descending branches of profunda brachii arteries**: in front & at the back of the lateral epicondyle.



APPLIED ANATOMY**1. Subcutaneous parts of the humerus:**

The parts of the humerus which can be felt easily under the skin are:

- The medial(A) and lateral epicondyles(B) &
- The medial(C) and lateral supracondylar ridges(D).

2. Fractures: are common.

Common sites of fractures:

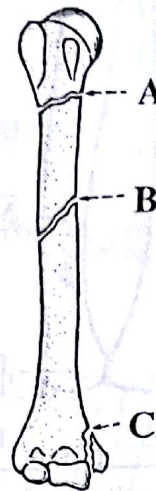
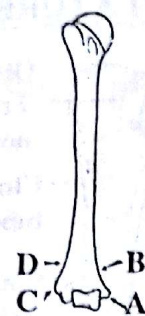
A. Surgical neck: being a weak point after the upper end.

B. Middle of the shaft: because it is:

1. Thinnest part of the bone.
2. Junction between two halves different in cross section.
3. The site of the spiral groove and nutrient foramen.

C. Medial epicondyle: because it is:

1. Prominent and subcutaneous.
2. Late in ossification (remains separate up to 20 y.).
3. Attached to strong muscles which may detach it.

**Nerves which may be injured with fractures of the humerus:**

Site	The injured nerve	Effect of injury
A.	Circumflex nerve: around the surgical neck.	Flattened shoulder
B.	Radial nerve: in spiral groove.	Drop-hand or wrist.
C.	Ulnar nerve: behind med. epicondyle.	Claw hand

OSSIFICATION:

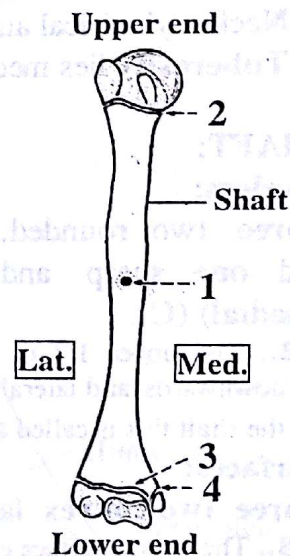
The humerus ossifies from **one primary center** for the shaft and **7 secondary centers** for the 2 ends.

The primary(1) center: in the middle of the shaft apex at 8th week of intrauterine life.

Secondary centers: one for each of: head, lesser tuberosity, greater tuberosity, capitulum and lateral part of the trochlea, lateral epicondyle and medial epicondyle.

- All appear after birth.
- **The upper end(2) fuses with the shaft at 18 years.**
- **The lower end(3) fuses with the shaft at 16 years.**
- **The medial epicondyle(4) fuses separately at about 20 years.**

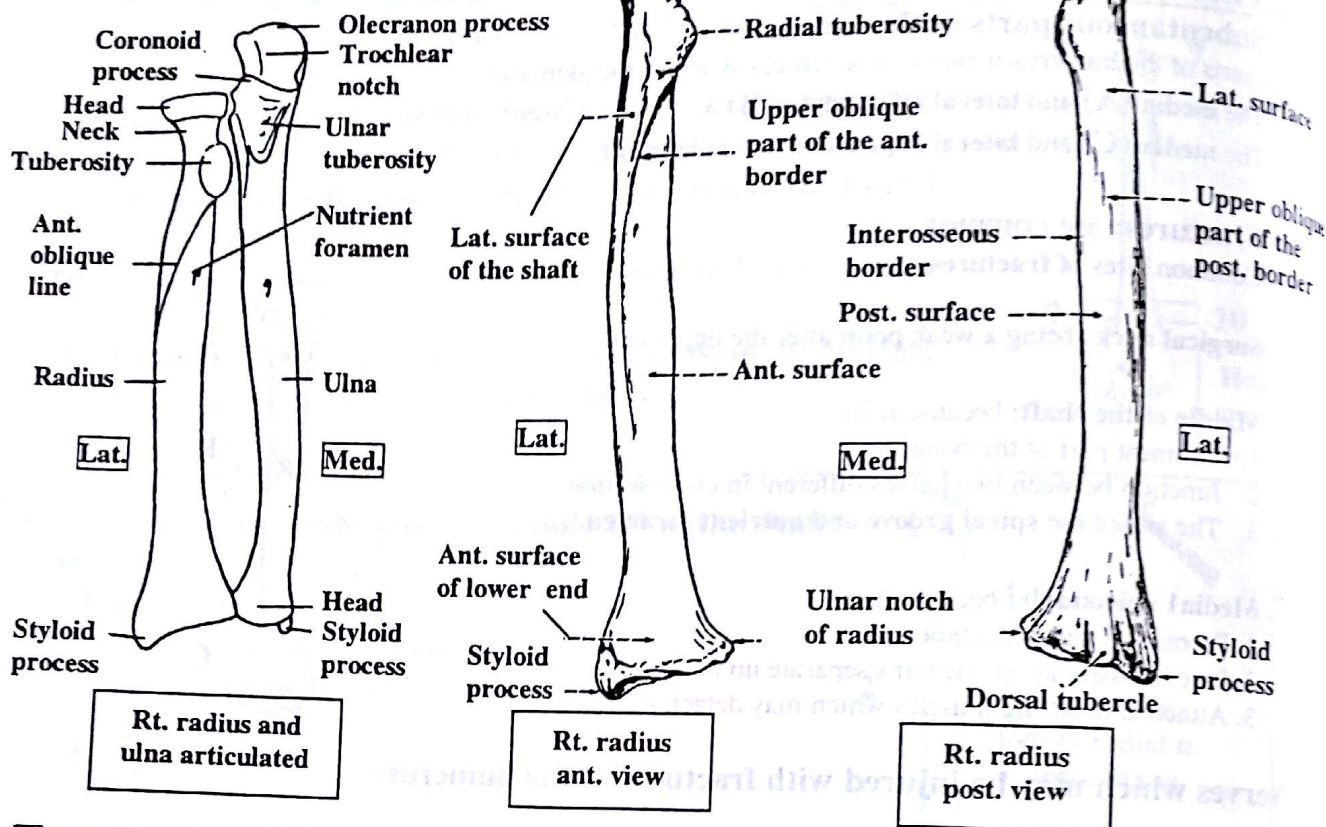
N.B.: In females fusion of the upper and lower ends of the bone with the shaft occurs 2 years earlier than in males.

**RADIUS**

It is the lateral bone of the forearm.

It articulates with the ulna at both the upper and lower ends to form the superior and inferior radio-ulnar joint.

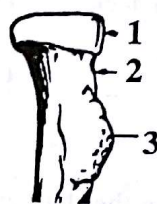
TYPE: Long bone.

GENERAL FEATURES:

The radius consist of: upper end, lower end and a shaft.

UPPER END: consist of:

1. Head: discoid,
2. Neck: cylindrical and
3. Tuberosity lies medially.



SHAFT:

Borders:

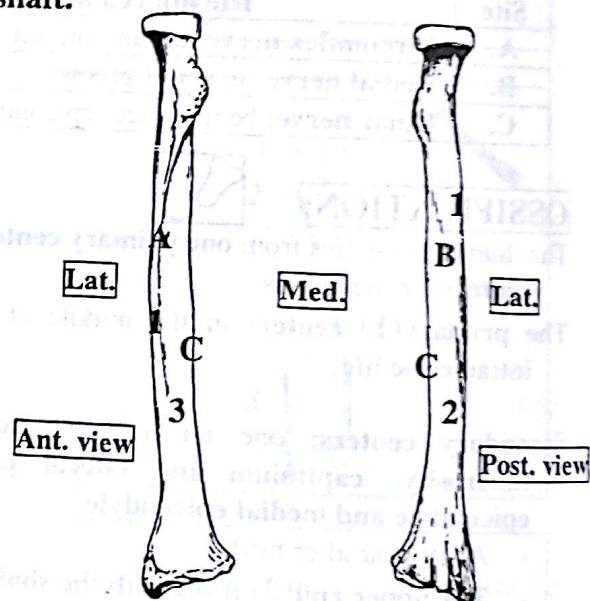
Three: two rounded; **anterior(A)** and **posterior(B)** and **one sharp and prominent; the interosseous (medial) (C)**.

N.B.: The upper 1/3 of the anterior border runs obliquely downwards and laterally from the radial tuberosity towards the shaft this is called **anterior oblique line**.

Surfaces:

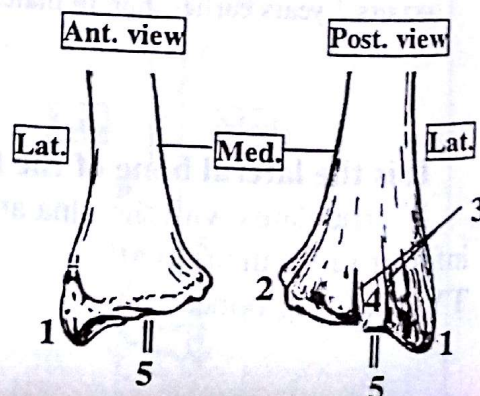
Three: **two convex; lateral(1) and posterior(2) and one concave; the anterior(3)**.

N.B.: The lateral surface encroaches on the upper parts of both the anterior and posterior aspects of the radius.



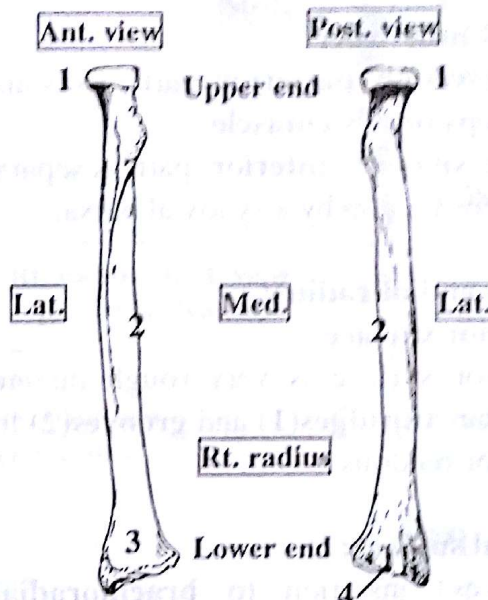
LOWER END:

- Large, carries the **styloid process(1)** laterally and the **ulnar notch(2)** of the radius medially.
- **Smooth and concave anteriorly** but **roughened by grooves(3)** and a **dorsal tubercle(4)** posteriorly.
- The **lower surface(5)** articulates with the **carpus** (scaphoid and lunate).



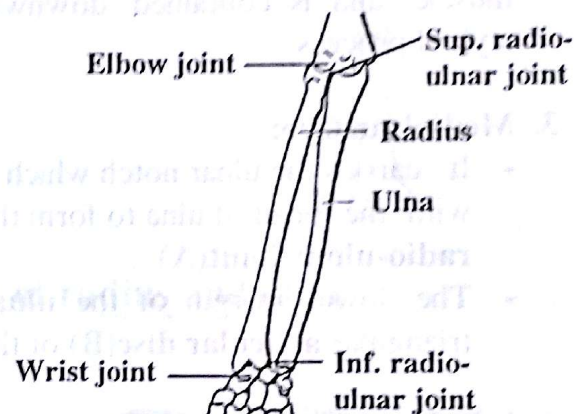
To identify the radius right or left:

1. The **upper end** is identified by the **head(1)**.
 2. The **lower end** is expanded.
 3. The **lateral border of the shaft is convex**.
 4. **Medially:** the **interosseous(2)** (medial) border is sharp.
 5. **Anteriorly:** the **lower end is smooth and concave(3)**.
 6. **Posteriorly:** the lower end is **rough and presents a tubercle(4)** and several grooves.
- This data enables the student to place the radius in its correct position.



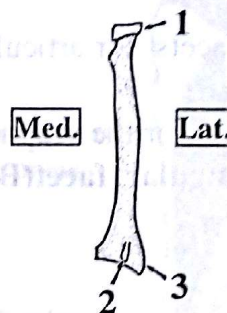
Articulations of the radius:

1. By the upper surface of the head with the capitulum of humerus (**elbow joint**).
2. By the circumference of the head with the radial notch of the ulna (**superior radio-ulnar joint**).
3. By the ulnar notch of the radius with the head of the ulna (**inferior radio-ulnar joint**).
4. By its lower end with the carpal bones (**wrist joint**).



Subcutaneous parts of radius:

1. **Head of radius:** is felt on the back of elbow.
2. **Styloid process:** is felt on the lateral side of the wrist in the anatomical snuff box.
3. **Dorsal tubercle:** lies in line with the interval between the index and middle fingers.



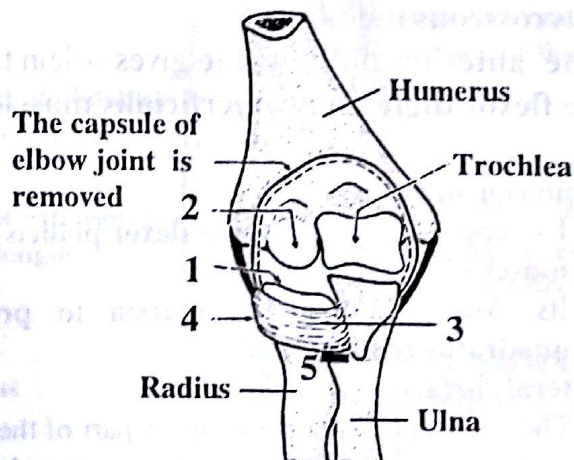
PARTICULAR FEATURES

A. Upper end of radius:

1. Head:

The head articulates with 2 bones:

- By its **upper surface(1)**: It articulates with the **capitulum(2)** of the humerus to form the elbow joint.
- By its **medial surface**: It articulates with the radial notch of the ulna to form the **superior radio-ulnar joint(3)**.
- The lateral surface of the head is surrounded by the **annular ligament(4)**.

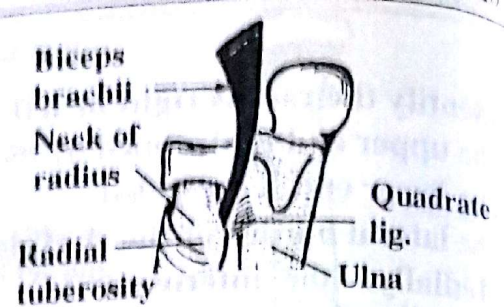


2. Neck of radius: It is loosely attached to:

- a. **Annular ligament(4)** of superior radioulnar joint.
- b. **Quadratus ligament(5)** (this ligament extends between the neck of radius and the ulna just below the radial notch).

3. Radial tuberosity:

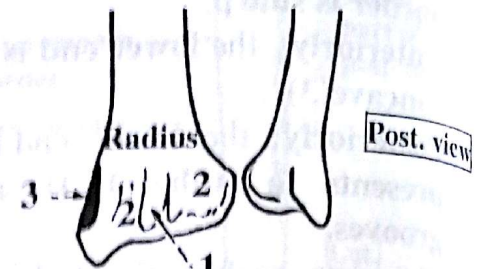
- The rough posterior part gives insertion to the biceps brachii muscle.
- The smooth anterior part is separated from the biceps tendon by a synovial bursa.



B. Lower end of radius:

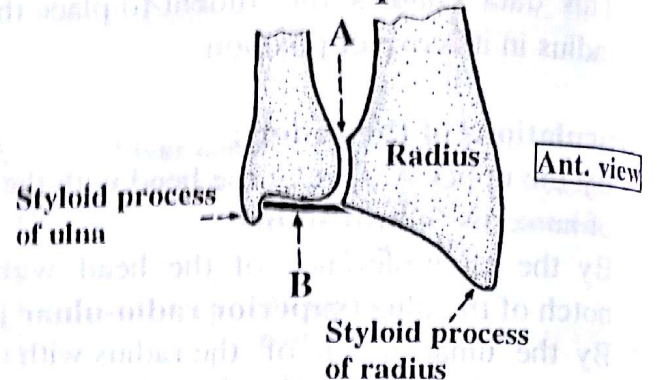
1. Posterior surface:

Posterior surface is very rough due to the presence of ridges(1) and grooves(2) for the extensor tendons.



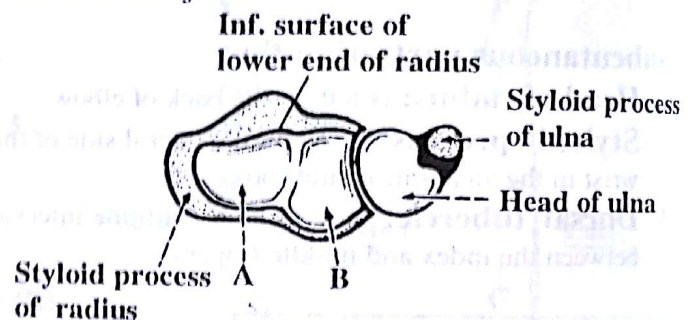
2. Lateral surface:

It gives insertion to brachioradialis(3) muscle, and is continued downwards as the styloid process.



3. Medial surface:

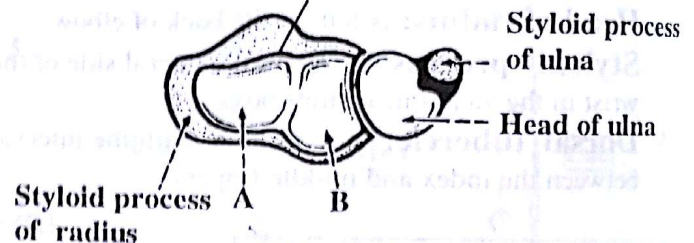
- It carries the ulnar notch which articulates with the head of ulna to form the inferior radio-ulnar joint(A).
- The lower margin of the ulnar notch gives attachment to the base of the triangular articular disc(B) of the inferior radio-ulnar joint.



4. Inferior surface:

It shows 2 articular facets for articulation with 2 bones of the wrist:

1. A triangular facet(A) for the scaphoid.
2. A medial quadrangular facet(B) for the lunate.



C. Shaft of radius:

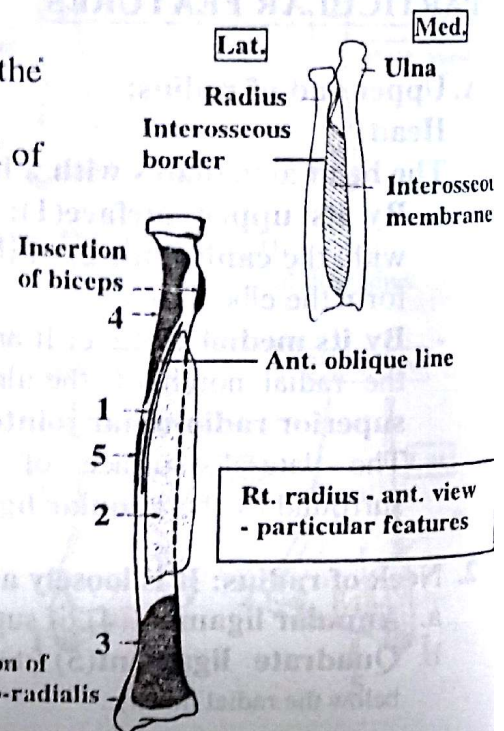
- Interosseous border:** its lower 3/4 give attachment to the interosseous membrane.
- The anterior oblique line** gives origin to the radial head of the flexor digitorum superficialis muscle(1).

iii. Anterior surface:

- a. Its upper 2/3 give origin to flexor pollicis longus muscle(2).
- b. Its lower 1/4 gives insertion to pronator quadratus muscle(3).

iv. Lateral surface:

- a. The V-shaped area in the upper part of the lateral surface gives insertion to supinator muscle(4)
- b. The rough impression on the middle of the lateral surface gives insertion to pronator teres muscle(5).



v. Posterior surface:

- Its upper 1/3 gives origin to abductor pollicis longus muscle(6).
- Its middle 1/3 gives origin to extensor pollicis brevis muscle(7).

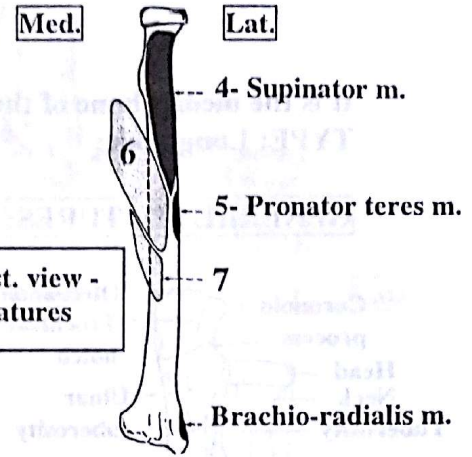
APPLIED ANATOMY

The styloid process is lower than that of the ulna by one cm.

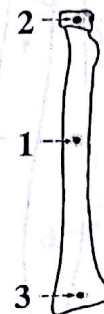
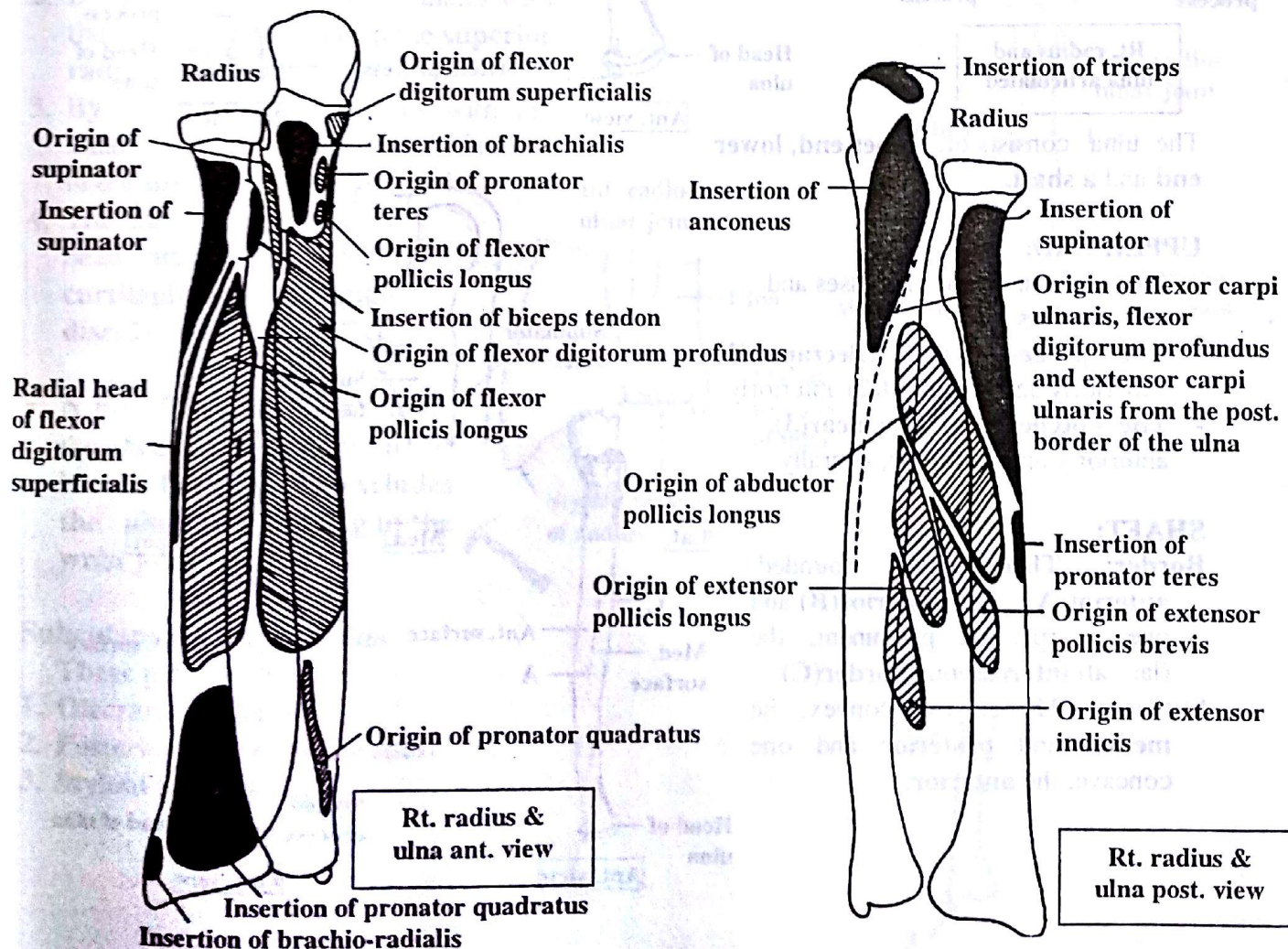
N.B.: Abduction of the wrist joint is more limited than adduction because the styloid process of the radius is longer than that of the ulna.

OSSIFICATION:

- The shaft ossifies from one primary center(1) appears by the 8th week of intra uterine life.
- A secondary center for the head(2) appears in the 5th year. The head fuses with the shaft by the age of 6 years.
- Another secondary center for the lower end(3) appears by the end of the 1st year. The lower end unites with the shaft at the age 18 years.



Rt. radius - post. view - particular features

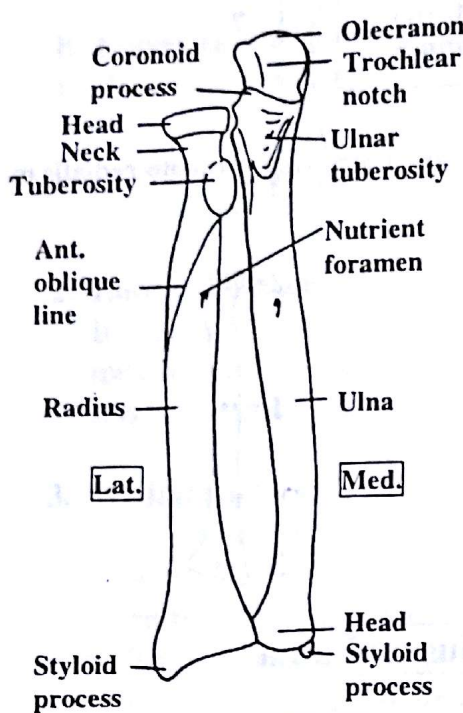
**Summary for the muscular attachment of radius and ulna**

Rt. radius & ulna ant. view

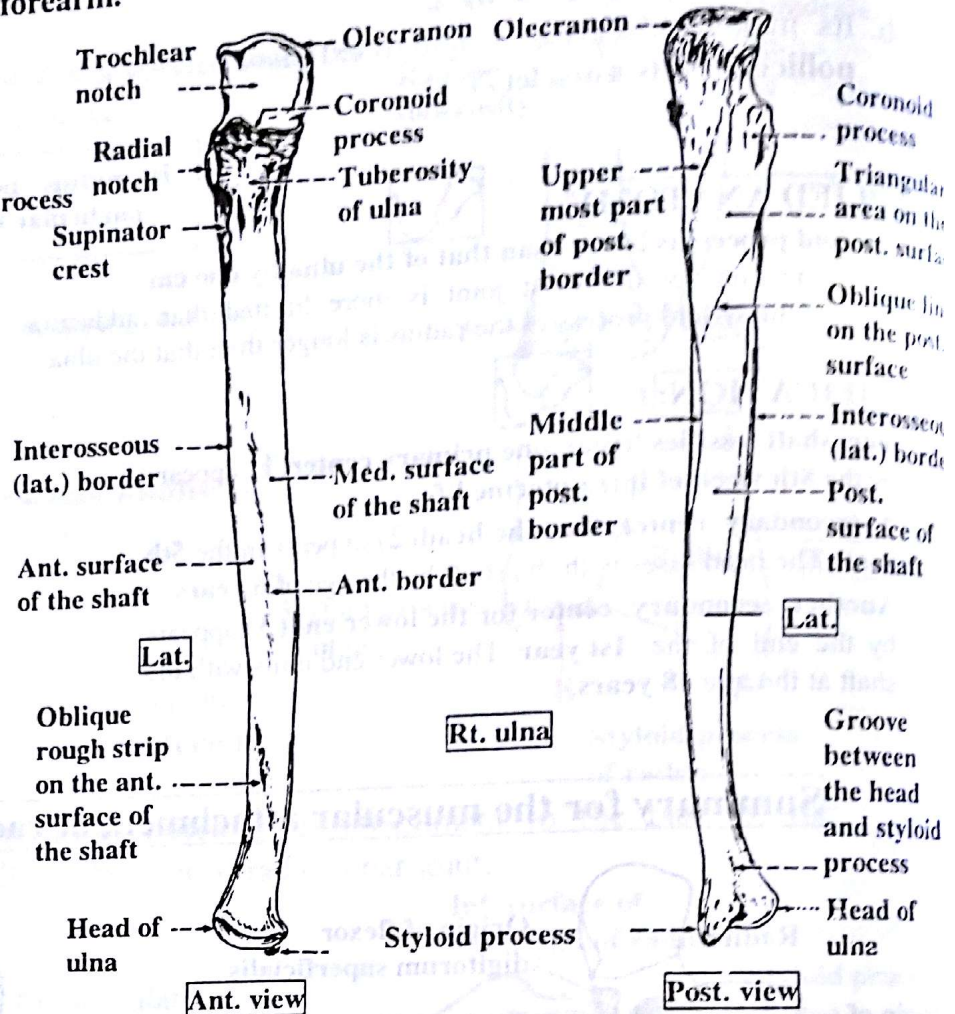
Rt. radius & ulna post. view

ULNA

It is the medial bone of the forearm.
TYPE: Long bone:

GENERAL FEATURES:

Rt. radius and ulna articulated



The ulna consists of: Upper end, lower end and a shaft.

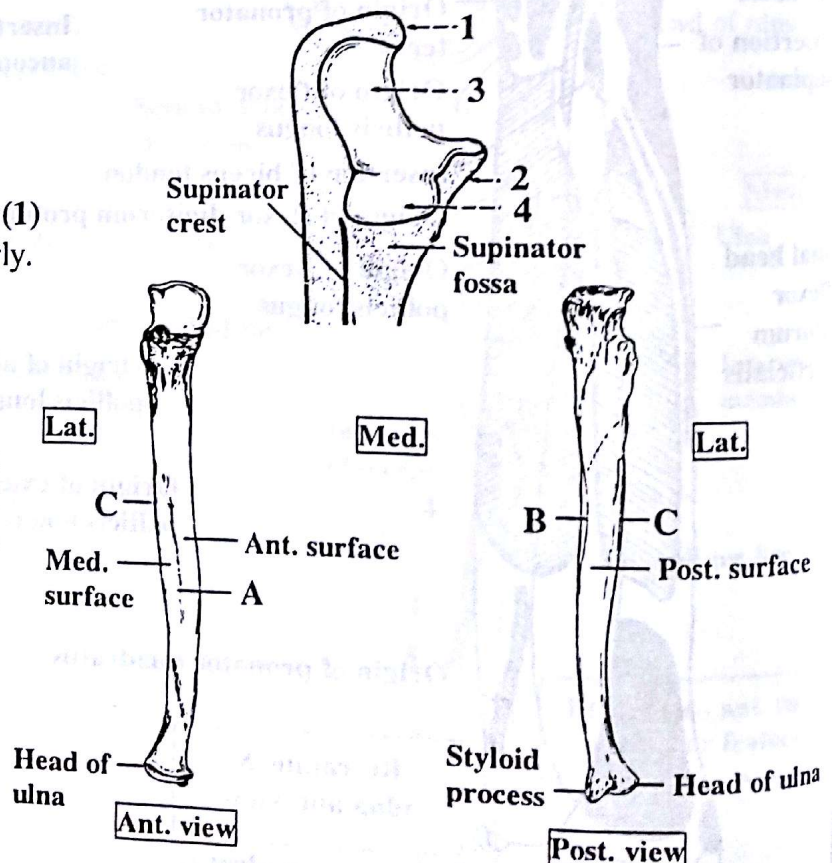
UPPER END:

- Large, carries: two processes and two notches.
- The processes are: Olecranon(1) superiorly and coronoid(2) anteriorly.
- The notches are: Trochlear(3), anteriorly and radial(4), laterally.

SHAFT:

Border: Three: two rounded; anterior(A) and posterior(B) and one sharp and prominent; the (lateral) interosseous border(C).

Surfaces: Three: two convex; the medial and posterior and one concave, the anterior.

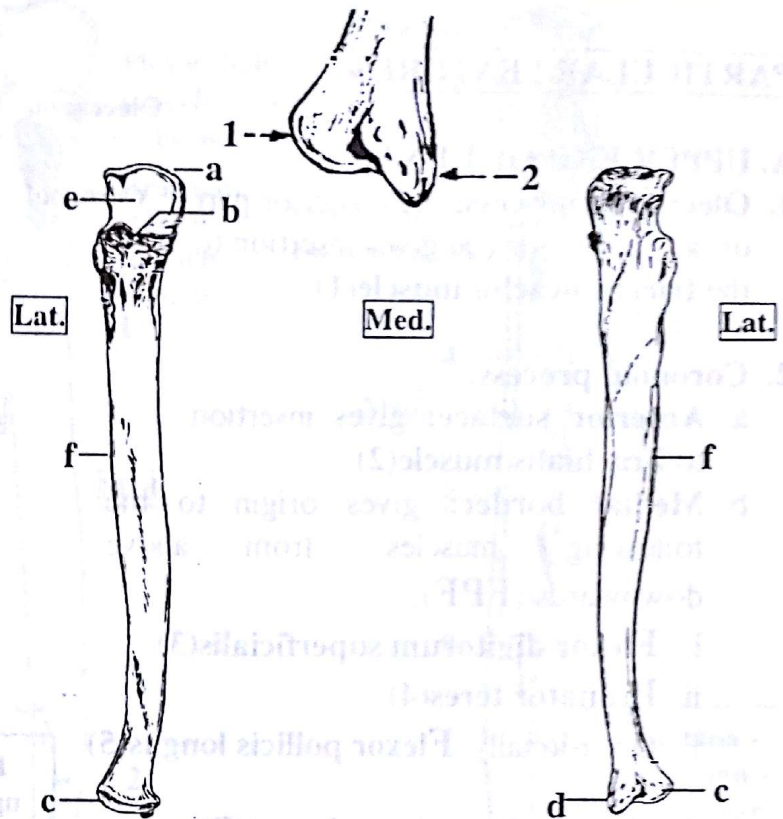


LOWER END:

- It has small **head(1)** anteriorly and
- A **styloid process(2)** posteriorly.

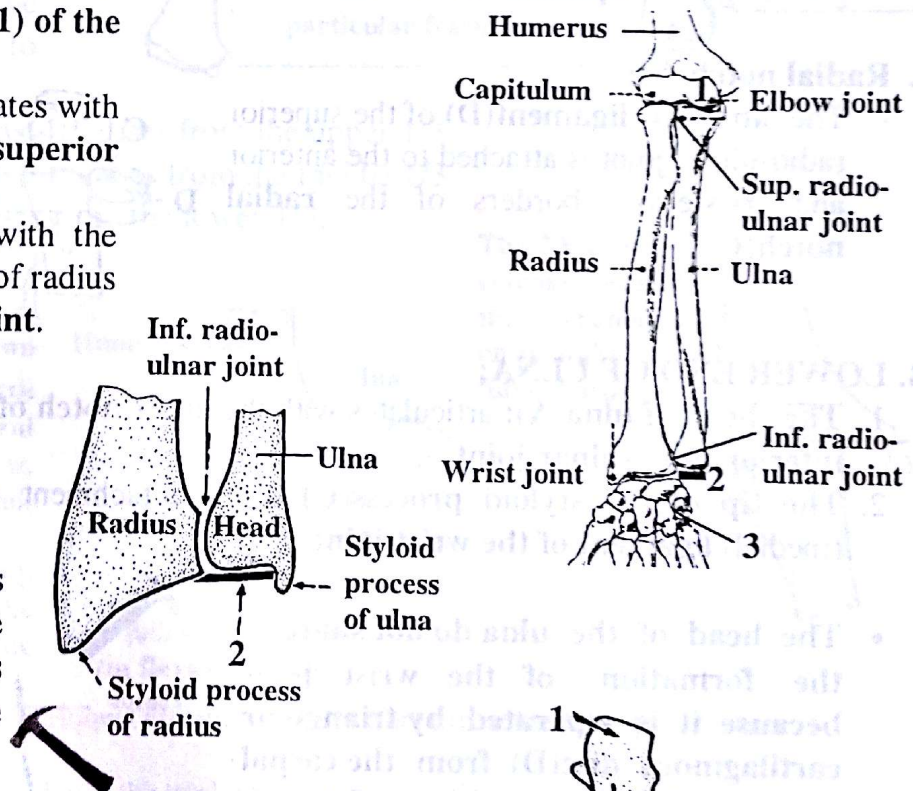
To identify the ulna right or left:

1. The **upper end** is identified by being hook shaped having 2 process: the **olecranon(a)** and the **coronoid(b)**.
 2. The **lower end** is small and carries the **head(c)** and **styloid process(d)**.
 3. The **anterior surface** by the concavity of the hook [the **trochlear notch(e)** which is directed forwards].
 4. The **lateral border(f)** (interosseous) of the shaft is sharp.
- The student is now able to put the ulna in its correct side.

**Articulations of the ulna:**

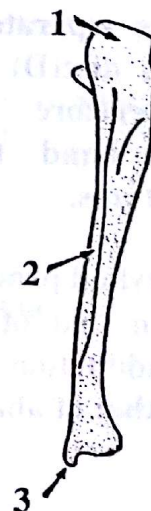
1. By its trochlear notch, the ulna articulates with the **trochlea(1)** of the **humerus** in the **elbow joint**.
2. By its radial notch, it articulates with the head of the radius in the **superior radio-ulnar joint**.
3. By its head, it articulates with the ulnar notch of the lower end of radius in the **inferior radio-ulnar joint**.
4. The inferior surface of the head articulates with a **cartilaginous articular disc(2)**.

- **N.B.:** The disc(2) separates the head of ulna from the lunate bone(3) and excludes the ulna from sharing in the wrist joint.

**Subcutaneous parts of ulna:**

These parts are:

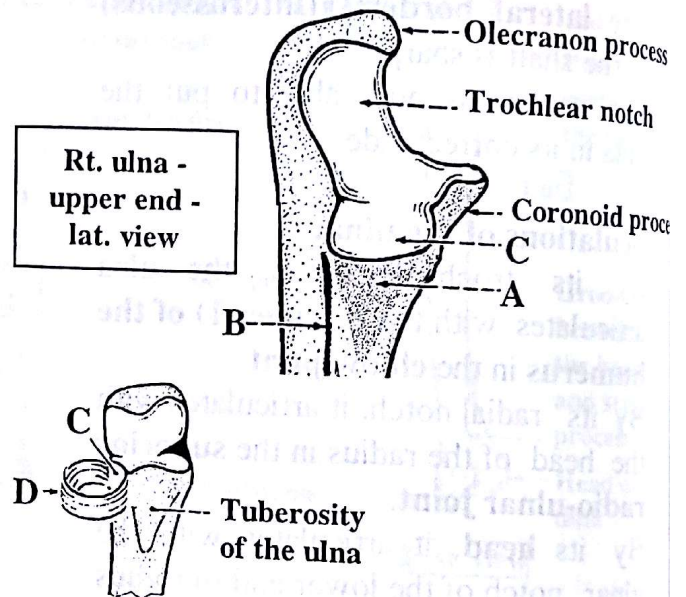
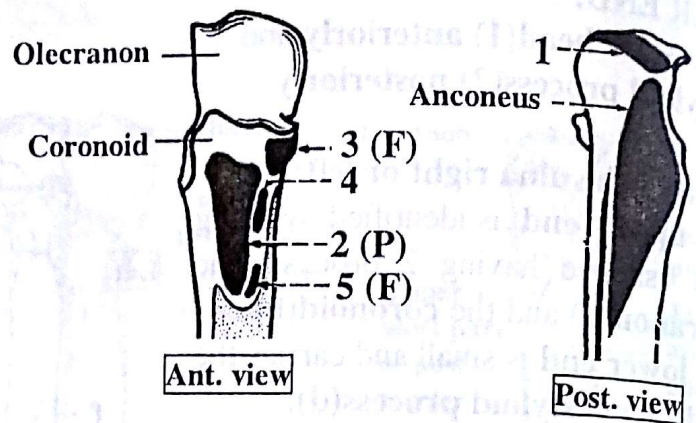
1. **Olecranon process.**
2. **Posterior border of the shaft.**
3. **Styloid process.**



PARTICULAR FEATURES

A. UPPER END OF ULNA:

1. **Olecranon process:** the posterior part of its upper surface gives insertion to the triceps brachii muscle(1).
2. **Coronoid process:**
 - a. **Anterior surface:** gives insertion to brachialis muscle(2).
 - b. **Medial border:** gives origin to the following muscles from above downwards (FPF):
 - i. **Flexor digitorum superficialis**(3).
 - ii. **Pronator teres**(4).
 - iii. Occasionally, **Flexor pollicis longus**(5).
 - c. **Supinator fossa(A) and crest(B):** give origin to supinator muscle.



3. Radial notch(C):

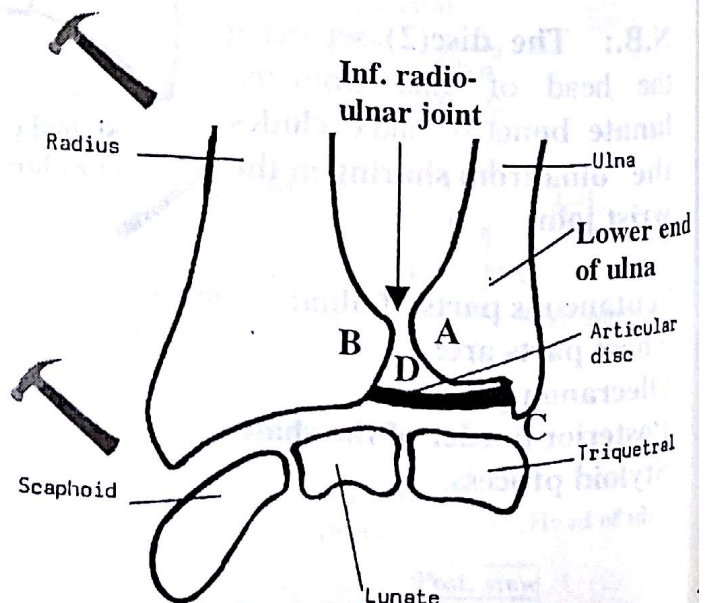
- The **annular ligament(D)** of the superior radio-ulnar joint is attached to the anterior and posterior borders of the **radial notch(C)**.

B. LOWER END OF ULNA:

1. The **head of ulna(A)**: articulates with the **ulnar notch of radius(B)** to form the **inferior radio-ulnar joint**.
2. The **tip of the styloid process(C)**: gives attachment to the **ulnar collateral (medial) ligament of the wrist joint**.

- The head of the ulna do not share in the formation of the wrist joint because it is separated by triangular cartilaginous disc(D) from the carpal bones. Therefore on a fall on outstretched hand the ulna usually escapes fractures.

- Since the styloid process of the ulna is shorter than that of the radius, the range of adduction of the wrist is larger than that of abduction.



C. SHAFT OF ULNA:**1. Posterior border:**

It gives attachment to an aponeurosis which gives origin to the following muscles:

- Flexor carpi ulnaris(a).
- Flexor digitorum profundus(b).
- Extensor carpi ulnaris(c).

2. Anterior and medial surfaces:

- a. The upper 3/4 of the anterior and medial surfaces give origin to flexor digitorum profundus muscle(1).
- b. The lower 1/4 of the anterior surface gives origin to pronator quadratus muscle(2).

3. Posterior surface:

- a. The part above the oblique line gives insertion to the anconeus muscle(3).
- b. The lateral part below the oblique line gives origin to the following 3 muscles:
 - i. Abductor pollicis longus(4): arises from the upper 1/3.
 - ii. Extensor pollicis longus(5): arises from the middle 1/3.
 - iii. Extensor indicis(6): arises from the lower 1/3.

APPLIED ANATOMY

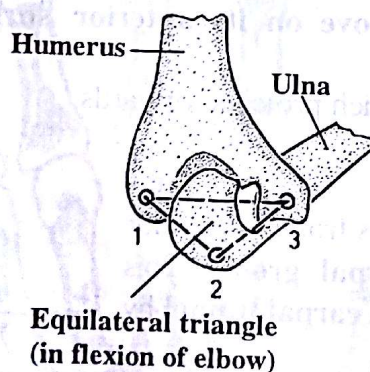
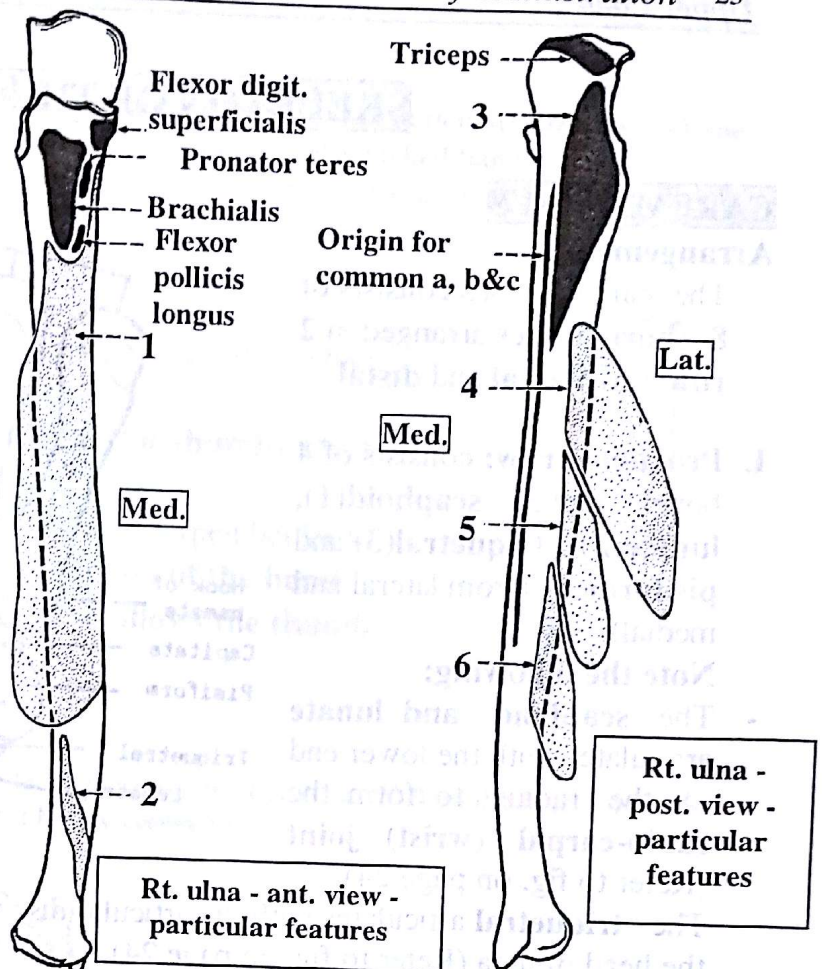
1. The olecranon(2) with the two epicondyles(1&3) of the humerus form the apices of an equilateral triangle in full flexion of the elbow, but are on a straight line in full extension.

Disturbance in this relationship means either fracture of any of the three processes or dislocation of the ulna at the elbow.

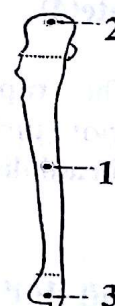
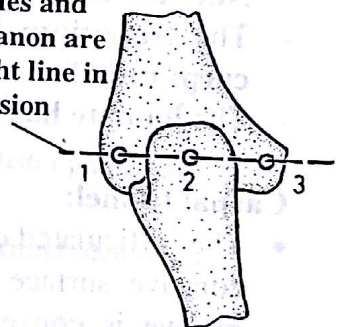
2. In case of bleeding, never make the tourniquet around two bones (forearm or leg) the artery escapes the pressure between the two bones.
3. Due to the projection of the medial edge of the trochlea, there is an angle between the long axis of the ulna and that of the humerus (165°); this is the carrying angle (page 13).

OSSIFICATION:

1. A primary center(1) for the shaft appears by the 8th week of intrauterine life:
2. 2 Secondary centers: one for the top(2) of olecranon (appears in the 10th years) and one for the lower end(3) (appear at the 5th year).
3. The upper end unites with the shaft of 16 year.
4. The lower end unites with the shaft of 18 year.



The 2 humeral epicondyles and the olecranon are on straight line in full extension



SKELETON OF THE HAND

CARPAL BONES

Arrangement:

The carpal bones consists of 8 short bones arranged in 2 rows: proximal and distal.

- I. Proximal row:** consists of 4 bones named **scaphoid(1)**, **lunate(2)**, **triquetral(3)** and **pisiform(4)** (from lateral and medial).

Note the following:

- The **scaphoid** and **lunate** articulate with the lower end of the radius to form the **radio-carpal (wrist) joint** (Refer to fig. on page 24).
- The **triquetral** articulates with the articular disc which separates the triquetral from the head of ulna (Refer to fig. on page 24).
- The **pisiform** lies in front of the triquetral.

- II. Distal row:** consists of 4 bones named **trapezium(5)**, **trapezoid(6)**, **capitate(7)** and **hamate(8)** (from lateral and medial).

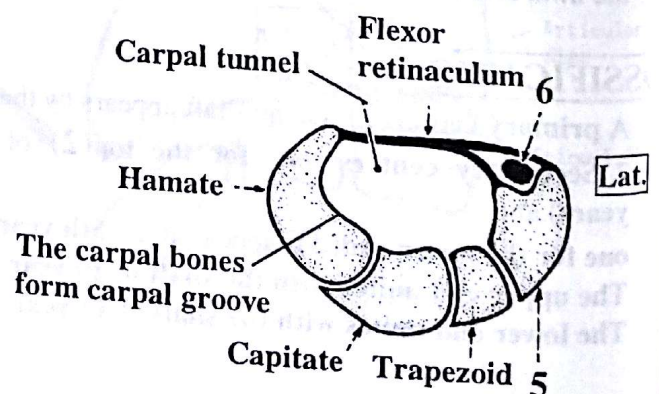
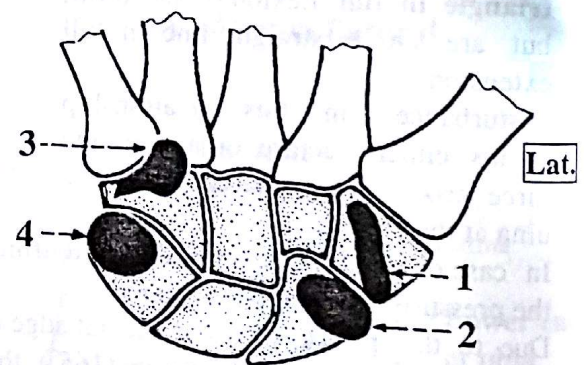
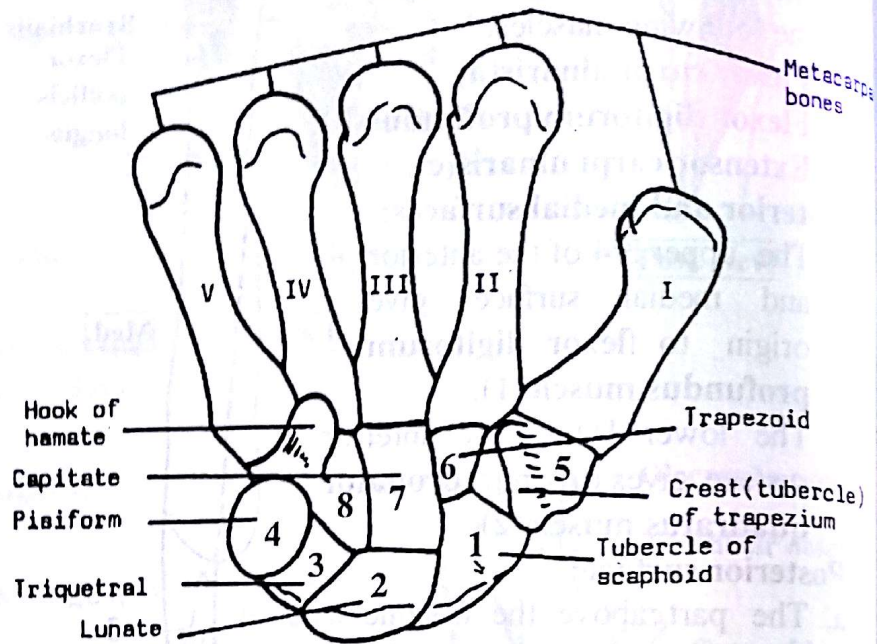
Note the following:

- The **trapezium** has a groove on its anterior surface for the tendon of **flexor carpi radialis**.
- The **hamate** has a **hook** which projects forwards.

Carpal tunnel:

- The articulated carpal bones from an anterior concave surface called **carpal groove**. This groove is converted into a **carpal tunnel** by the **flexor retinaculum**.
- The **flexor retinaculum** is attached **laterally** to the **tubercle of scaphoid(1)** and **crest of trapezium(2)**, and
- **Medially** to the **pisiform(3)** and **hook of the hamate(4)**.

N.B.: The **trapezium(5)** has a groove on its anterior surface for the tendon of **flexor carpi radialis(6)**.



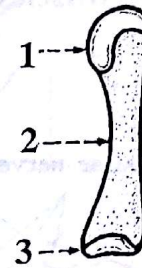
APPLIED ANATOMY



1. Fractures are common in the scaphoid and lunate because they articulate directly with the radius; the weight of the body crushes them on a fall on the outstretched hand.
2. The scaphoid is liable to nonunion due to necrosis of the proximal part as it takes its blood supply from the distal part.

METACARPAL BONES

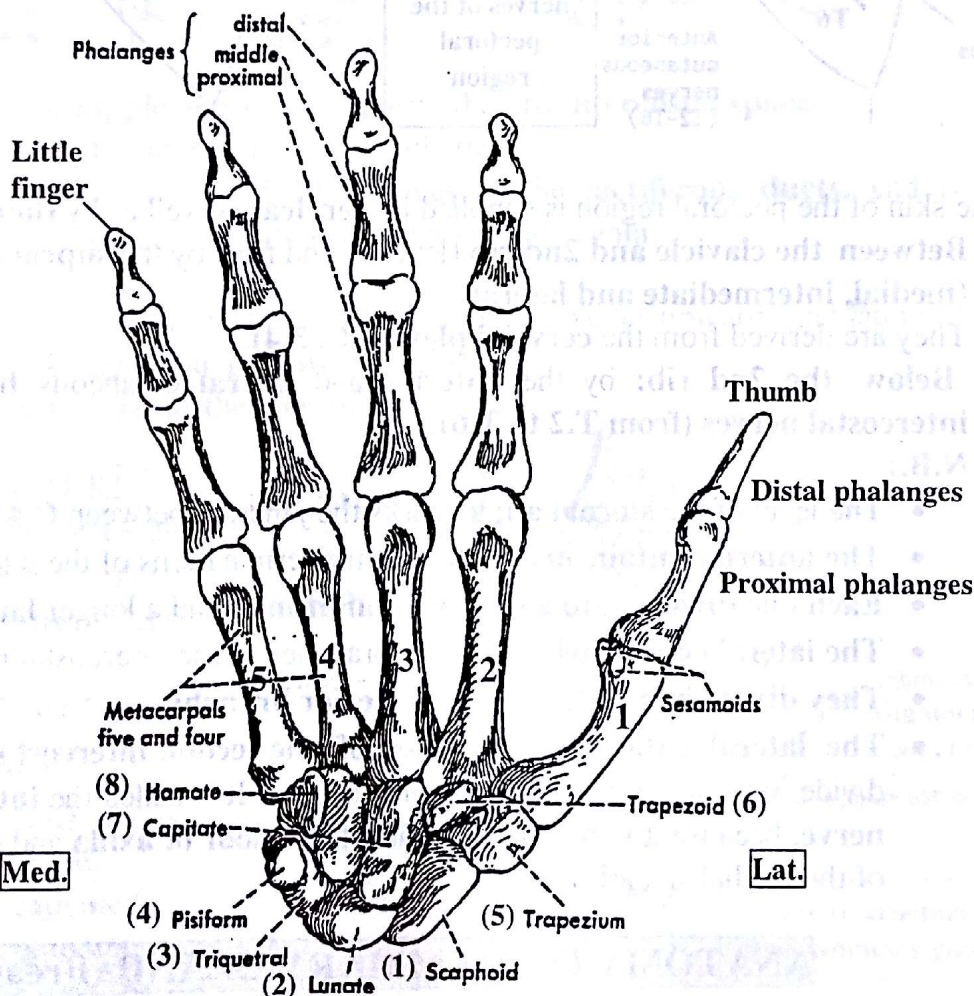
- There are 5 metacarpal bones (long bones) each of which has a head(1), shaft(2) and base(3).
- They lie side except the 1st metacarpal (for thumb) which lies on a more anterior plane.
- The first is shortest and lies separate and perpendicular to the other four, to give the grasping function of the hand.
- This position of the 1st metacarpal also allows the thumb to oppose the other fingers.



APPLIED ANATOMY



1. Due to the perpendicular position of the 1st metacarpal, the thumb has 70 % of the functions of the hand and should not be amputated except if highly necessary.



PHALANGES

Each digit has 3 phalanges: Proximal phalanx, middle phalanx and distal phalanx. However, the thumb has only 2 phalanges.

N.B.: The names of the fingers (from lateral and medial) are as follows:

1st; thumb, 2nd; index finger, 3rd; middle finger, 4th; ring finger, 5th; little finger.

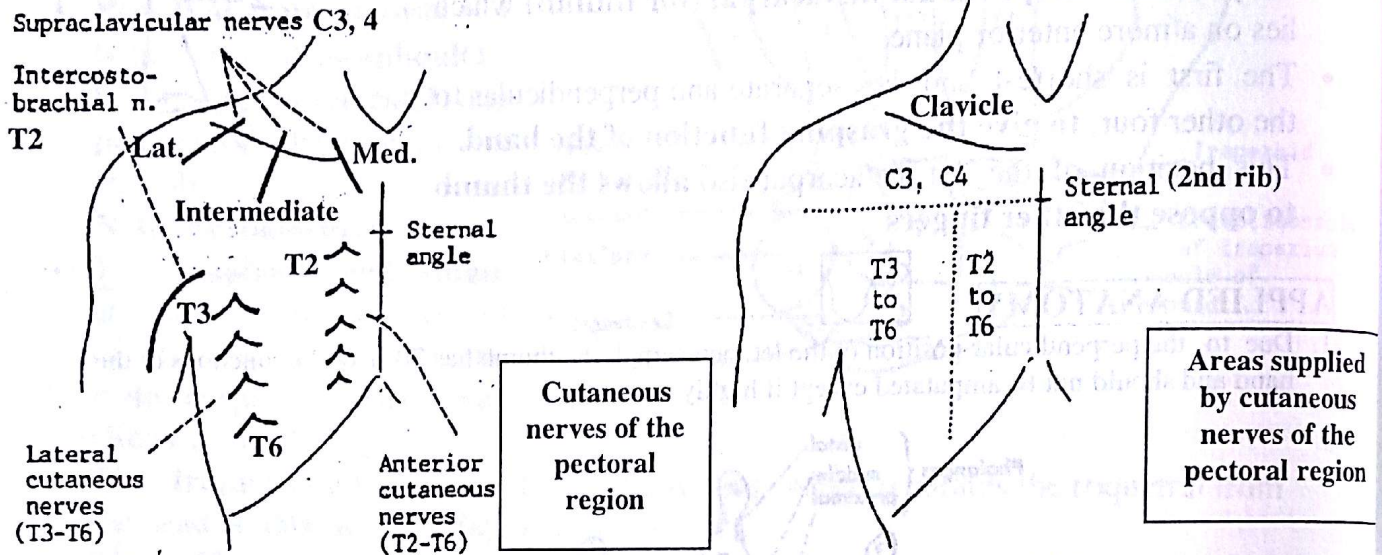
PECTORAL REGION

The pectoral region occupies the upper part of the front of the chest.

It comprises the following:

1. Skin and fascia.
2. The breast.
3. Muscles (pectoralis major, pectoralis minor and subclavius).

CUTANEOUS NERVES



The skin of the pectoral region is supplied by **cervical** as well as by **thoracic** nerves as follows:

1. **Between the clavicle and 2nd rib** (level of 2nd rib): by the **supraclavicular nerves** (medial, intermediate and lateral).

They are derived from the **cervical plexus** (C. 3,4).

2. **Below the 2nd rib**: by the **anterior and lateral cutaneous branches** of the **intercostal nerves** (from T.2 to T.6).

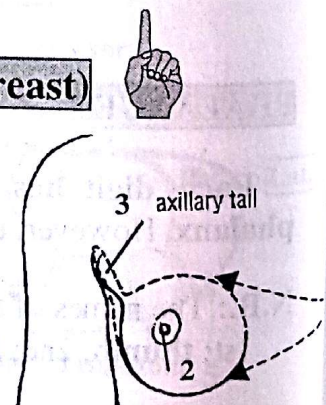
N.B.:

- The level of the **sternal angle** marks the junction between C.4 and T.2 nerves.
- The **anterior cutaneous nerves** are the terminations of the intercostal nerves.
- Each one divides into a short **medial branch** and a longer **lateral branch**.
- The **lateral cutaneous nerves** are branches of the intercostal nerves.
- They divide into **anterior and posterior branches**.
- The **lateral cutaneous branches of the second intercostal nerve** does not divide into anterior and posterior branches. It is called the **intercostobrachial nerve**, because it supplied the skin of the floor of axilla and skin of the upper of the medial side of the arm.

ANATOMY OF MAMMARY GLAND (Breast)

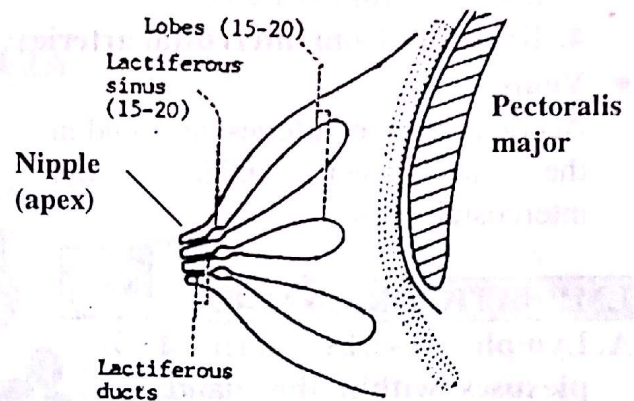
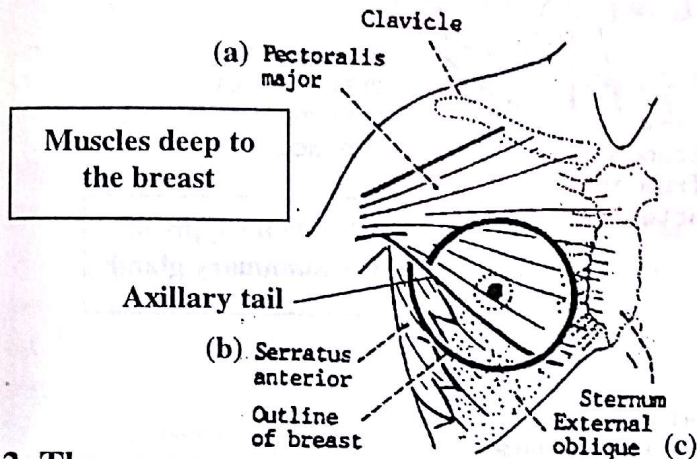
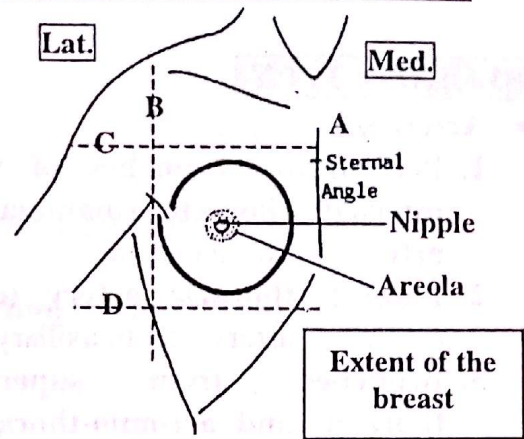
PARTS OF THE GLAND:

The mammary gland (breast) lies in the superficial fascia and is formed of the following parts [**base**(1), **apex**(2) and **axillary tail**(3)]:



1. The base:

- It is wide and extends from the sternum(A) medially to the mid-axillary line(B) laterally, and from the 2nd rib(C) above to the 6th rib(D) below.
- It lies on the following 3 muscles:
 - a. Pectoralis major (mainly).
 - b. Serratus anterior.
 - c. External oblique muscle of the abdomen.



2. The apex:

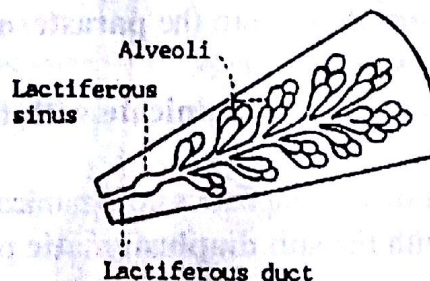
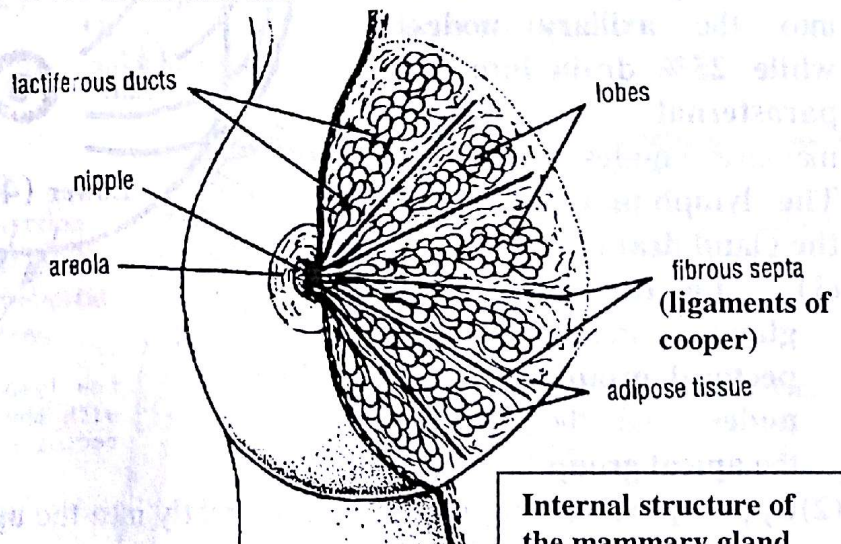
- It is formed by the **nipple** which lies opposite the **4th intercostal space**.
- It is devoid of fat but contains smooth muscle fibers.
- The nipple is pierced by **15-20 orifices** of the **lactiferous ducts**, and is surrounded by an area of pigmented skin called the **areola**.

3. Axillary tail:

- It is an extension of the base of the gland which passes upwards and laterally along the lower border of the **pectoralis major**.
- It reaches upwards as far as the level of the 3rd rib.

INTERNAL STRUCTURE:

- The gland consists of **15-20 lobes** which run in a radial direction away from the nipple.
- Each lobe is drained by a **lactiferous sinus** > **lactiferous duct** which opens separately on the nipple.
- The gland has **no capsule** but is embedded in fatty tissue.
- Its lobes are separated from each other by **fibrous septa** which pass from the deep fascia to the overlying skin and are called **suspensory ligaments of Cooper**.



Structure of one lobe of the mammary gland

Internal structure of the mammary gland

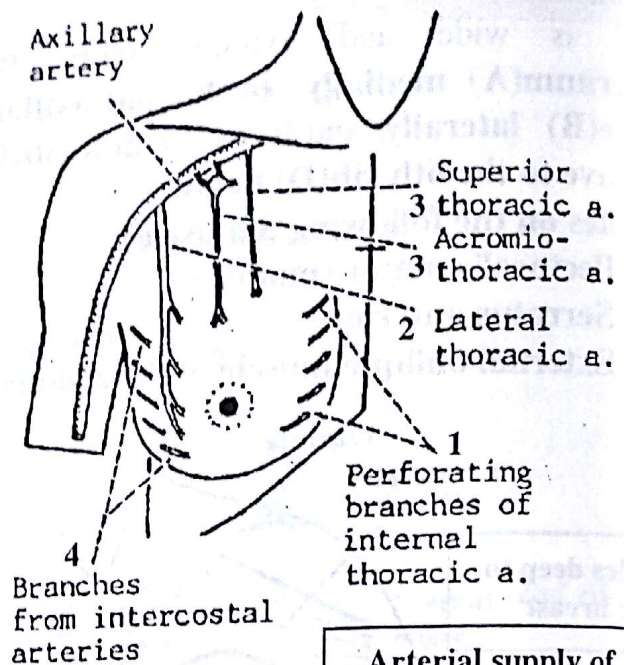
BLOOD SUPPLY:

• Arteries:

1. Perforating branches of the internal thoracic (mammary) artery (from subclavian).
2. Lateral thoracic artery (external mammary artery) (from axillary).
3. Branches from superior thoracic and acromio-thoracic arteries (from axillary).
4. Branches from intercostal arteries.

• Veins:

Accompany the arteries and end in the subclavian, axillary and intercostal veins.



LYMPHATIC DRAINAGE:

A. Lymph vessels: form 2 plexuses within the gland, as follows:

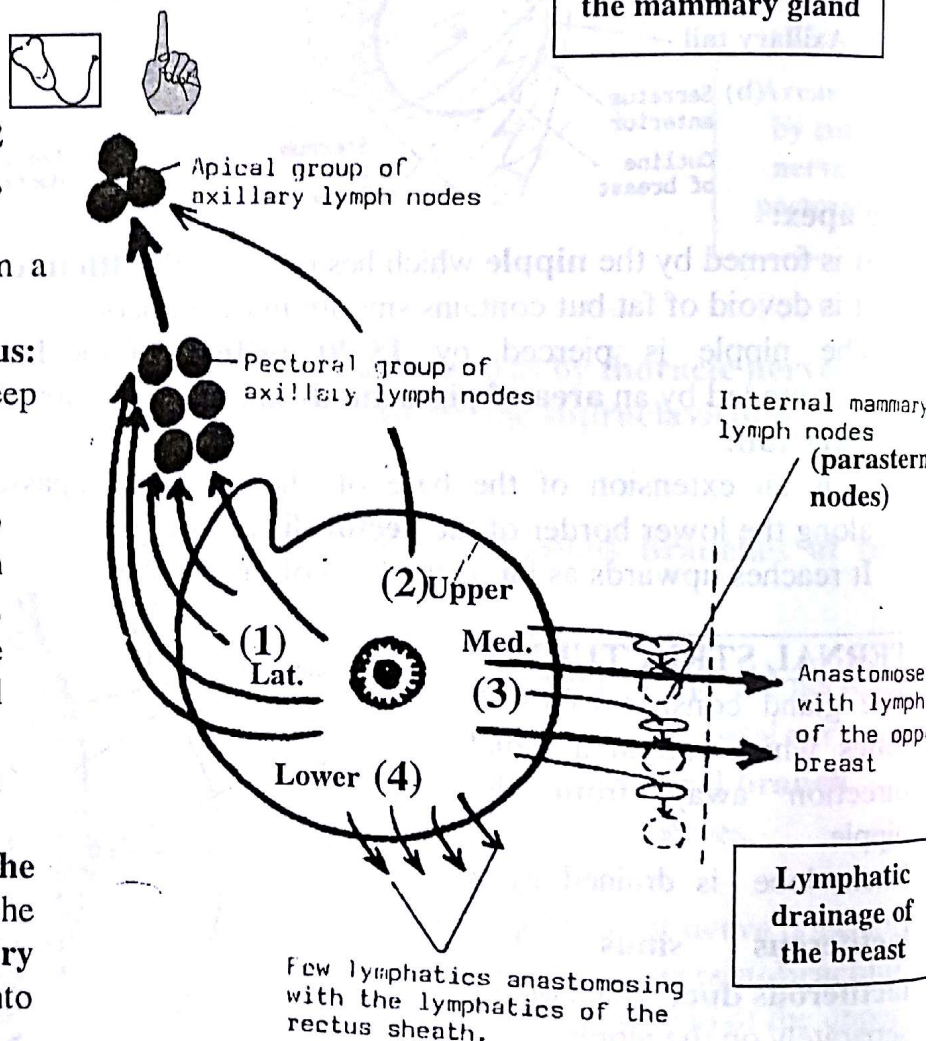
- a. Subareolar plexus: from a plexus beneath the areola.
- b. Deep lymphatic plexus: from a plexus on the deep fascia of pectoralis major.

B. Lymph nodes:

From these 2 plexuses, 75% of the lymphatic vessels drain into the axillary nodes, while 25% drain into the parasternal (internal mammary) nodes.

The lymph plexuses within the gland drain as follows:

- (1) Lateral part of the gland: drains into the pectoral group of axillary nodes, and thereafter into the apical group.
- (2) Upper part of the gland: drains directly into the apical group of axillary nodes.
- (3) Medial part of the gland: drains into the parasternal nodes which lie along the internal thoracic artery (inside the chest). The lymph vessels of this part communicate with those of the opposite breast across the skin and fascia.
- (4) Lower part of the gland: its lymphatics communicate with the lymphatic plexus of the rectus sheath and with the sub diaphragmatic plexus (beneath the diaphragm).



APPLIED ANATOMY:

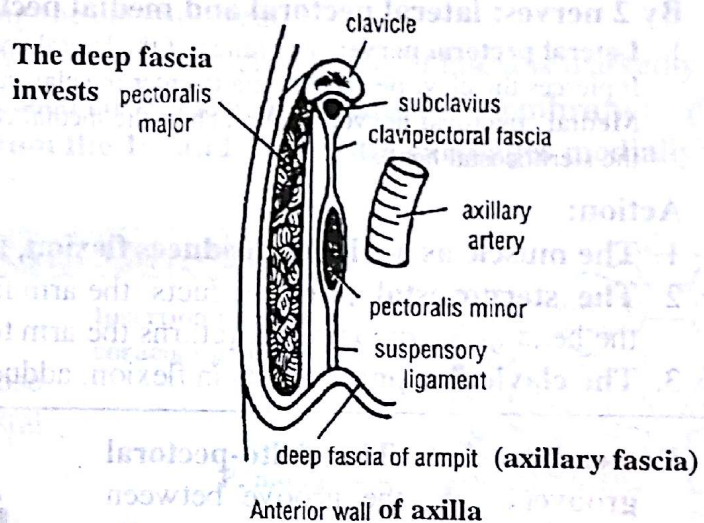
- The lactiferous ducts radiate outwards from the nipple, and accordingly **incision** of the gland should be made in a **radial direction** to avoid cutting across the ducts.
- Cancer breast is common. Infiltration of the **suspensory ligaments of Cooper** by cancer leads to their shortening. They, then pull on the overlying skin which becomes **dimpled** and the **nipple** may become retracted.
- Normally the gland moves easily on the underlying pectoralis major, but in case of advanced malignant tumor the **breast becomes fixed** to the muscle.

PECTORAL FASCIA

This is the deep fascia of the pectoral region.

It **invests the pectoral muscles** (pectoralis major & minor) and has the following extensions:

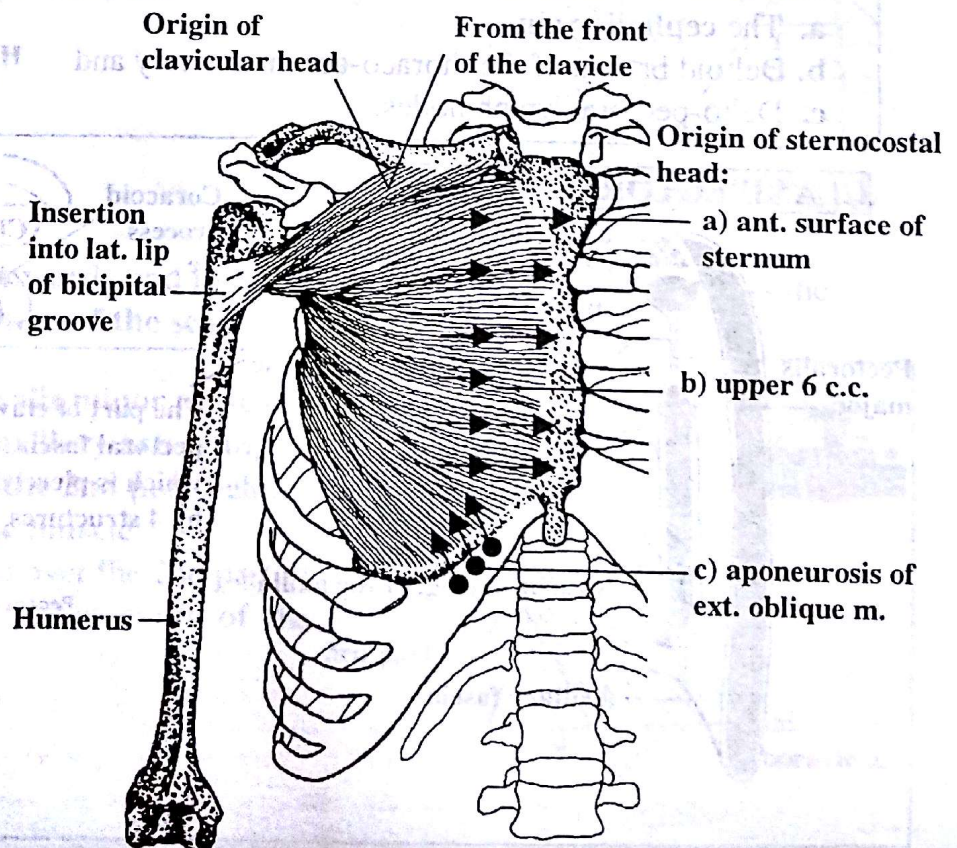
- Axillary fascia:** forms the floor of the axilla.
- Clavi-pectoral fascia:** lies deep to the clavicular head of the pectoralis major.

**PECTORALIS MAJOR**

- Origin:**

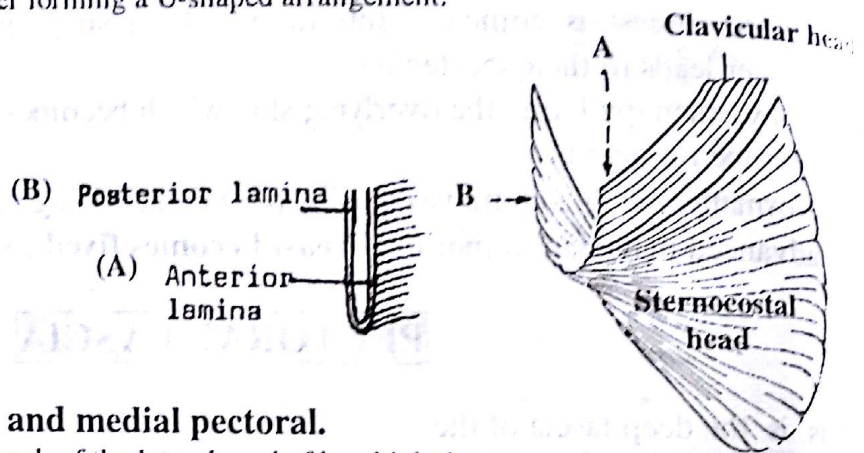
It arises by 2 heads (clavicular and sternocostal):

- Clavicular head:** from the medial 1/2 of the anterior surface of the clavicle.
- Sternocostal head:** from the following areas:
 - Anterior surface of the sternum.
 - Anterior surface of the upper 6 costal cartilages.
 - Aponeurosis of the external oblique muscle of the abdomen.



- **Insertion:**

- Into the lateral lip of the intertubercular (bicipital) groove of the humerus by a bilaminar tendon, which is described as follows:
- The bilaminar tendon is formed of 2 laminae (anterior and posterior) which are continuous with each other at its lower border forming a U-shaped arrangement.
- The anterior lamina(A) is formed by the clavicular head and upper fibers of the sternocostal head.
- While the posterior lamina(B) is formed by the lower fibers of the sternocostal head.



- **Nerve supply:**

By 2 nerves: lateral pectoral and medial pectoral.

1. **Lateral pectoral nerve:** is a branch of the lateral cord of brachial plexus. It pierces the clavi-pectoral fascia to enter the clavicular head.
2. **Medial pectoral nerve:** is a branch of the medial cord and pierces the pectoralis minor to enter the sternocostal head.

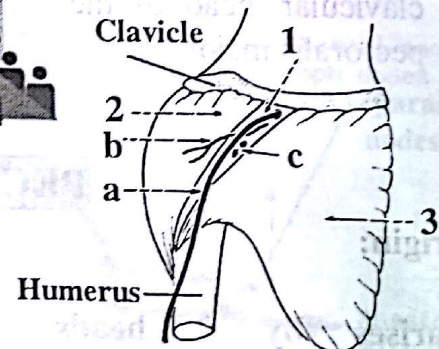
- **Action:**

1. **The muscle as a whole:** produces flexion, adduction and medial rotation of the arm
2. **The sternocostal part:** adducts the arm from the fully abducted position above the head as in climbing (i.e. returns the arm to resting position).
3. **The clavicular part:** assists in flexion, adduction and medial rotation of the arm.

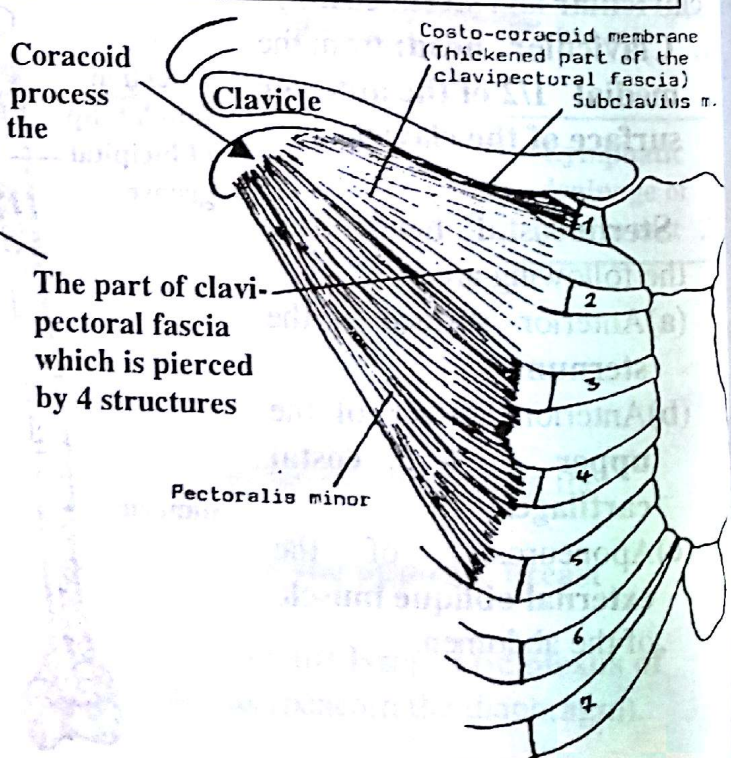
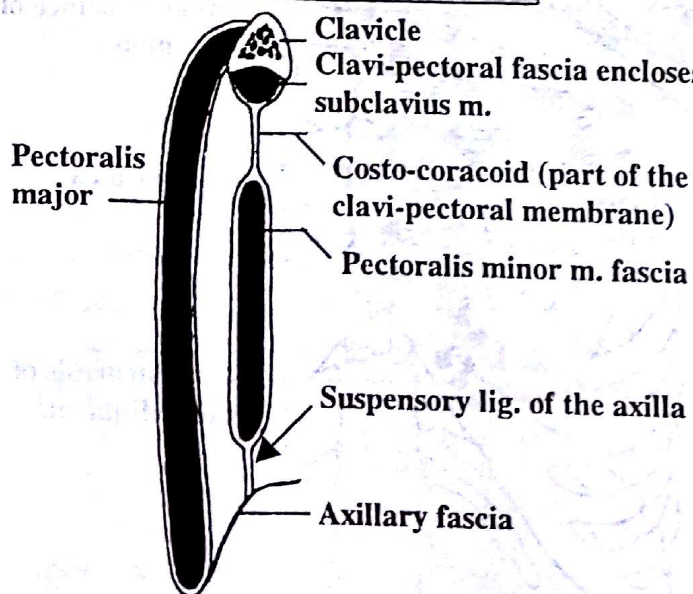
Remember that: The delto-pectoral groove(1) is the groove between deltoid muscle(2) and pectoralis major muscle(3).

The groove contains:

- a. The cephalic vein,
- b. Deltoid branch of the thoraco-acromial artery and
- c. Delto-pectoral lymph nodes.



CLAVIPECTORAL FASCIA:



- The **clavi-pectoral fascia** is a thickened part of fascia that lies deep to pectoralis major muscle.
- Its **upper part** splits into 2 layers, which **enclose the subclavius muscle** and are attached to the lips of the groove on the clavicle for that muscle.
- Its **lower end** splits to **surround pectoralis minor muscle** and proceeds downwards to the axillary fascia.
- The part below the pectoralis minor sometimes called **suspensory ligament of the axilla** because it is responsible for rising the floor of the axilla when the arm is abducted from the side.
- The clavi-pectoral fascia is pierced by the following 4 structures:
 1. Thoraco-acromial artery.
 2. Cephalic vein.
 3. Lateral pectoral nerve.
 4. Few lymph vessels which run along the cephalic vein.
- Along the lower border of subclavius muscle, the clavi-pectoral fascia is markedly thickened to form a strong ligament called **costo-coracoid ligament (membrane)**. This ligament (membrane) extends from the 1st and 2nd costal cartilages medially to the coracoid process laterally.



PECTORALIS MINOR

- **Origin:**
From the **3rd, 4th and 5th ribs** close to their junction with the costal cartilages.

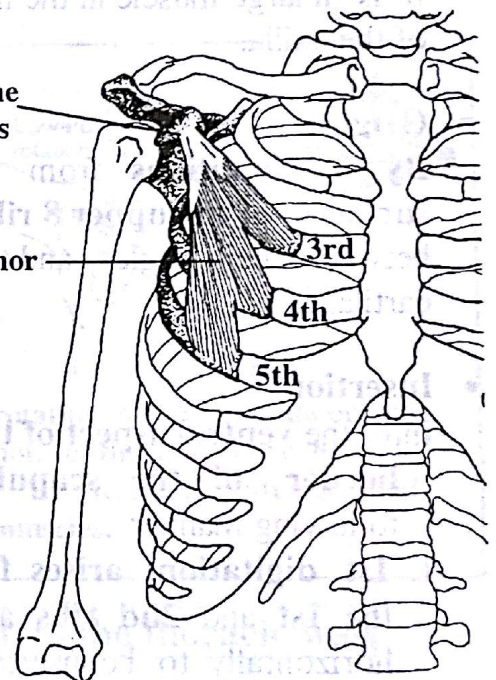
- **Insertion:**
Into the **upper surface and medial border of the coracoid process**, near its tip (not the tip).

- **Nerve supply:**
Medial pectoral nerve.

- **Action:**
It **draws the scapula downwards and forwards** on the chest wall, i.e. it assists the serratus anterior in **protraction of the scapula** (the fig. on page 35).

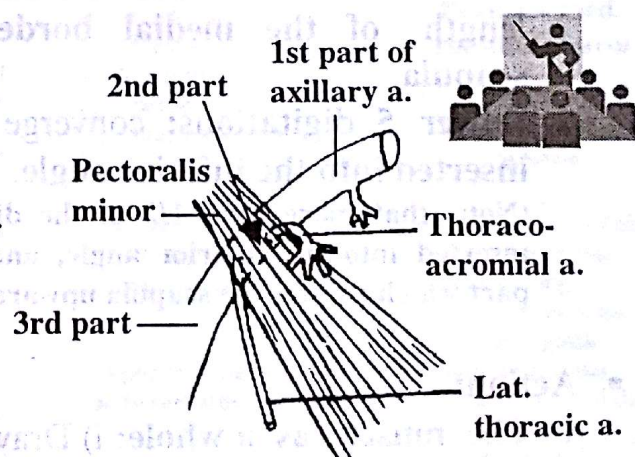
Insertion into the coracoid process

P. minor



Remember that about pectoralis minor muscle:

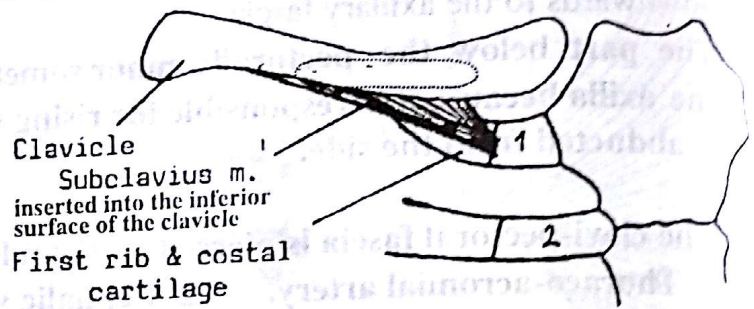
1. The muscle divides the axillary artery into 3 parts: the 1st part above, the 2nd part behind and the 3rd part below the muscle.
2. The pectoralis minor crosses over the 2nd part of axillary artery and the related cords of the brachial plexus.



3. The upper border of the muscle is related to the structures which pierce the clavi-pectoral fascia & its border is related to the lateral thoracic artery.

SUBCLAVIUS

- **Origin:** from the upper surface of the 1st rib at junction with its costal cartilage.
- **Insertion:** into the groove on the inferior surface of the clavicle.
- **Nerve supply:** nerve to subclavius (C5, 6) (from the upper trunk of the brachial plexus).
- **Action:** i) Depresses the clavicle & ii) Steadies, fixes the clavicle during movements of the shoulder girdle.



SERRATUS ANTERIOR

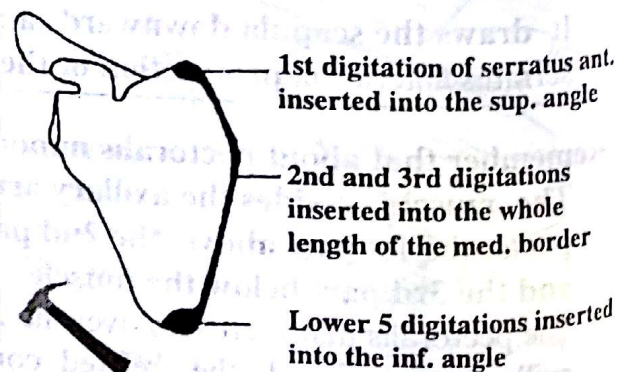
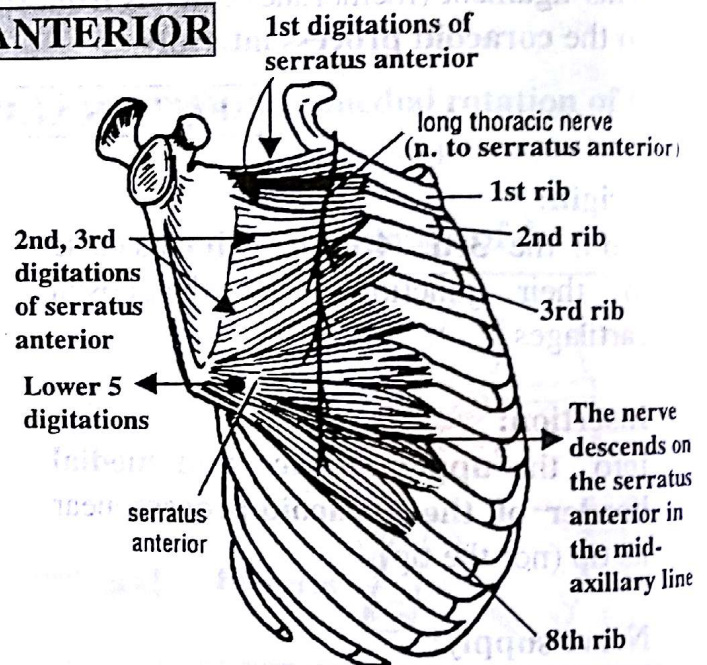
It is a large muscle in the medial wall of the axilla.

- **Origin:**
By 8 digitations from the outer surfaces of the upper 8 ribs midway between their angles and their costal cartilages.

- **Insertion:**

Into the ventral aspect of the medial border of the scapula in the following manner.

1. **1st digitation:** arises from both the 1st and 2nd ribs and passes horizontally to be inserted into the superior angle of the scapula.
2. **2nd and 3rd digitations:** spread in a fan-like manner to be inserted into the whole length of the medial border of the scapula.
3. **Lower 5 digitations:** converge on to be inserted into the inferior angle. (Note that more than 1/2 of the digitations is inserted into the inferior angle, and this is the part which rotates the scapula upwards).



- **Action:**

1. **The muscle as a whole:** i) Draws the scapula forwards around the thoracic wall i.e. protracts (pulls forwards) the scapula (the fig. on page 35).

2. The lower 5 digitations: ii) Acting with trapezius muscle, the serratus anterior rotate, the scapula upwards in raising the arm above the head (in the movement of abduction of the shoulder more than 90°) (the fig. on page 35).

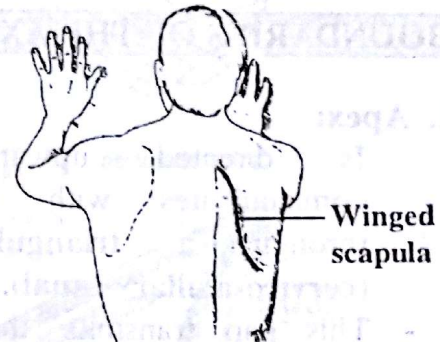
• **Nerve supply:**

- From the long thoracic nerve (nerve to serratus anterior) (C. 5, 6, 7). This nerve originates from the roots of the brachial plexus in the neck, and descends vertically on the serratus anterior in the mid-axillary line.

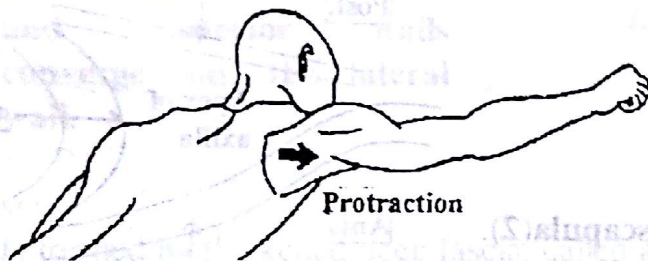


Injury of the long thoracic nerve (nerve to serratus anterior):

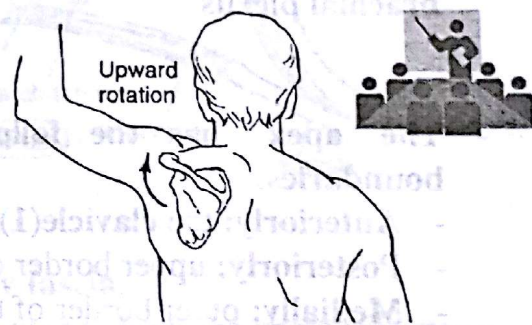
- The nerve to serratus anterior is subcutaneous in the medial wall of the axilla and is exposed to injury especially during radical mastectomy (removal of the breast) leading to winged-scapula
- In this deformity, the medial border of the scapula projects away from the chest.
- There is loss of abduction of the arm (at shoulder joint) more than 90° .



Remember that:



Protraction of the scapula is produced by serratus anterior and pectoralis minor.



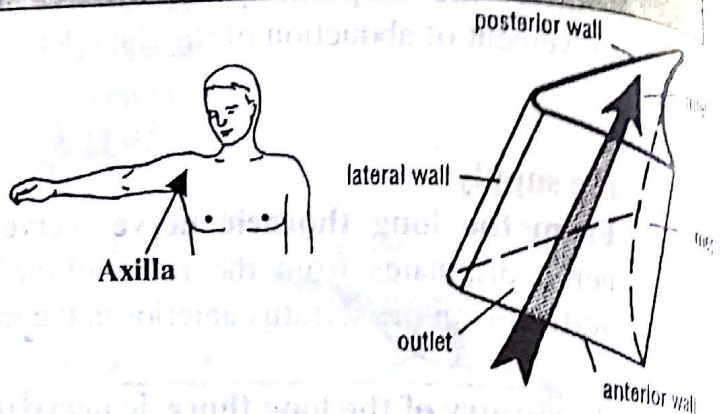
Upward rotation of the scapula occurs in abduction of the arm above 90° . It is produced by serratus anterior and trapezius muscles.

Summary for muscles connecting the upper limb to the thoracic wall

Name of Muscle	Origin	Insertion	Nerve Supply	Action
Pectoralis major	Clavicle, sternum, and upper six costal cartilages + ext. oblique m.	Lateral lip of bicipital groove of humerus	Medial and lateral pectoral nerves from brachial plexus	Adduction + flexion + med. rotation of arm
Pectoralis minor	Third, fourth, and fifth ribs	Coracoid process of scapula	Medial pectoral nerve from brachial plexus	Protraction of the scapula
Subclavius	First rib & First costal cartilage	Clavicle	Nerve to subclavius from upper trunk of brachial plexus	Depresses the clavicle and steadies this bone during movements of the shoulder girdle
Serratus anterior	Upper eight ribs	Medial border and inferior angle of scapula	Long thoracic nerve n. to serratus anterior	Draws the scapula forward around the thoracic wall; rotates scapula

AXILLA

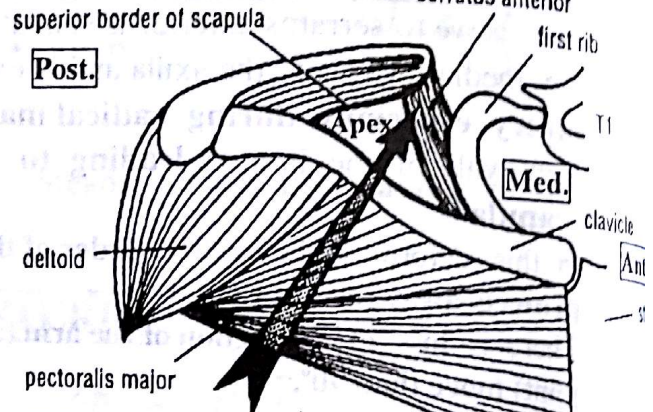
- It is a pyramidal space between the **arm** (laterally) and the **chest wall** (medially).
- It has **4 walls** (anterior, posterior, medial and lateral) and an **apex** directed upwards and a **base** directed downwards.



BOUNDARIES OF THE AXILLA:

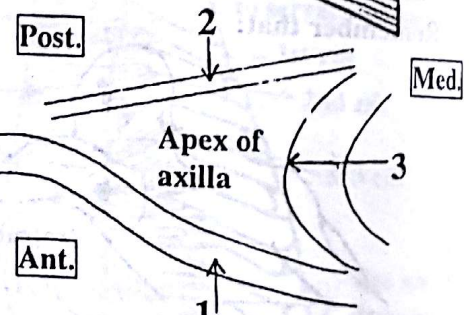
1. Apex:

- Is directed upwards and communicates with the neck through a **triangular gap** (cervico-axillary canal).
- This gap transmits the **axillary vessels** and the **cords of the brachial plexus**.



- The **apex** has the following boundaries:

- **Anteriorly:** the clavicle(1).
- **Posteriorly:** upper border of the scapula(2).
- **Medially:** outer border of the 1st rib(3).

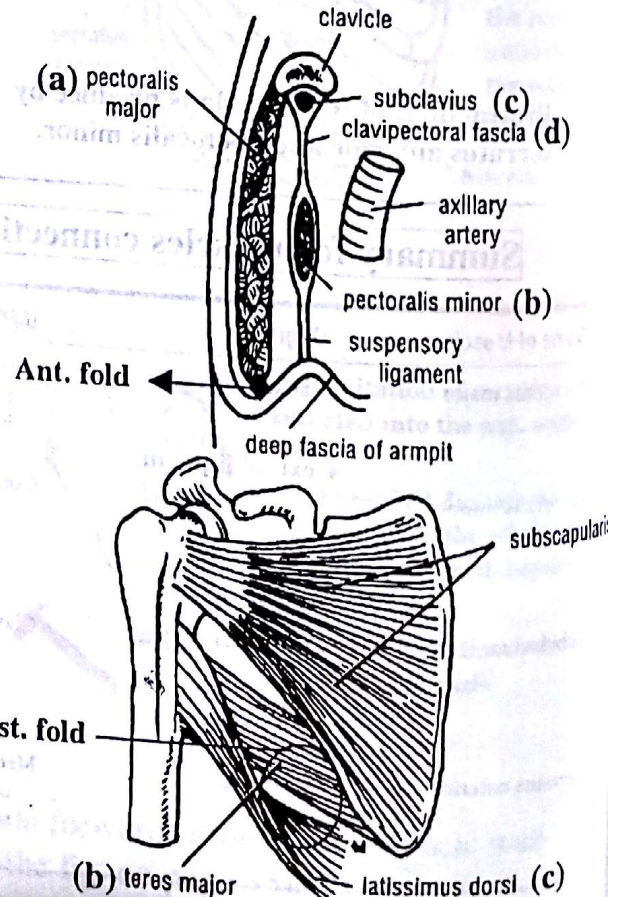


2. Anterior wall: formed by:

- **Pectoralis major(a).**
- **Pectoralis minor(b).**
- **Subclavius(c).**
- **Clavipectoral fascia(d).**
- The lower margin of the anterior wall is called the **anterior fold**.
- The **anterior fold** is formed by the **pectoralis major only**.

3. Posterior wall: formed by:

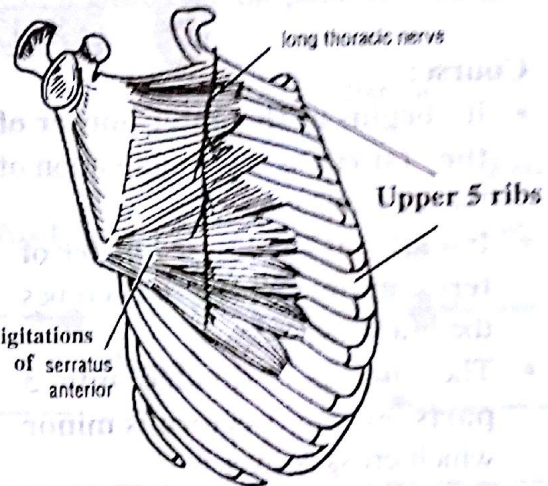
- **Subscapularis(a).**
- **Teres major(b)**
- **Latissimus dorsi(c)**
- The lower margin of the posterior wall is called the **posterior fold**.
- The **posterior fold** is formed by the **teres major and latissimus dorsi**.



- The posterior fold extends downwards more than the anterior fold.

4. Medial wall: formed by:

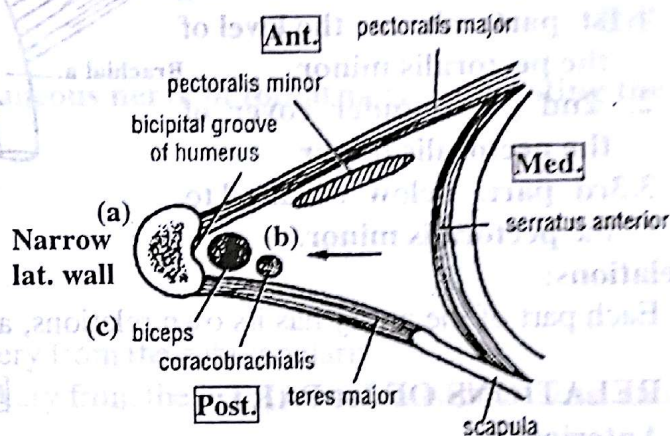
- Upper 5 ribs and related intercostal spaces.
- Upper digitations of the serratus anterior which arise from the upper 5 ribs.



5. Lateral wall: formed by:

- Upper part of the shaft of the humerus(a).
- Coracobrachialis muscle(b).
- Short head of biceps(c) (where it joins the coracobrachialis).

Note: that the lateral wall of the axilla is narrow as compared with the medial wall. Thus, the anterior and posterior walls converge on the lateral wall.



6. Base:

- Is formed by thickened deep fascia, called **axillary fascia**.
- This fascia forms the **floor of the axilla** and extends from the pectoralis major in front to the latissimus dorsi behind.
- It becomes tense when the arm is abducted or raised above the head.

CONTENTS OF THE AXILLA:

1. **Axillary artery(a) and vein(b):** with the vein medial to the artery all through their course.

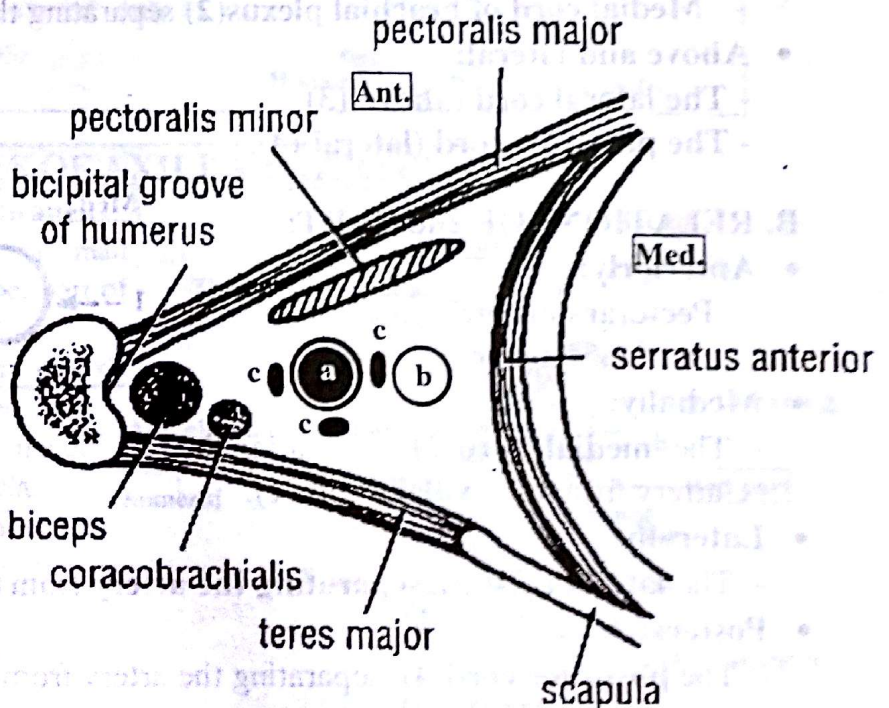
2. **Cords of brachial plexus(c):** which surround the 1st and 2nd parts of the axillary artery. However, their branches surround the 3rd part of the axillary artery.

3. **Axillary lymph nodes:**

These are arranged in groups each of which is related to one of the boundaries of the axilla.

4. **Axillary fat.**

It fills the whole space of the axilla and envelops its contents.





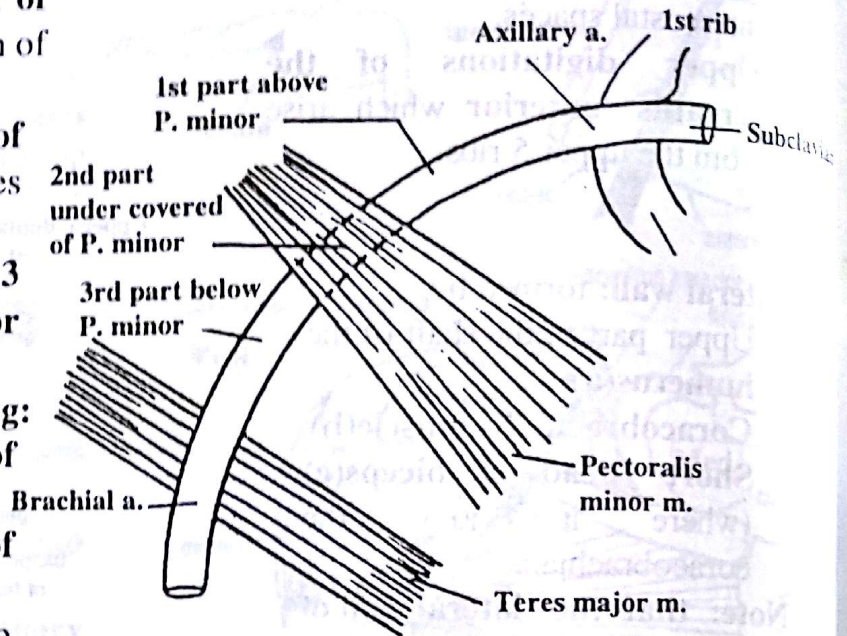
AXILLARY ARTERY

Course:

- It begins at the outer border of the 1st rib as the continuation of the subclavian artery.
- It ends at the lower border of teres major where it becomes the brachial artery.
- The artery is divided into 3 parts by the pectoralis minor which crosses over it.

These 3 parts are the following:

1. 1st part: above the level of the pectoralis minor.
2. 2nd part: under cover of the pectoralis minor.
3. 3rd part: below or distal to the pectoralis minor.

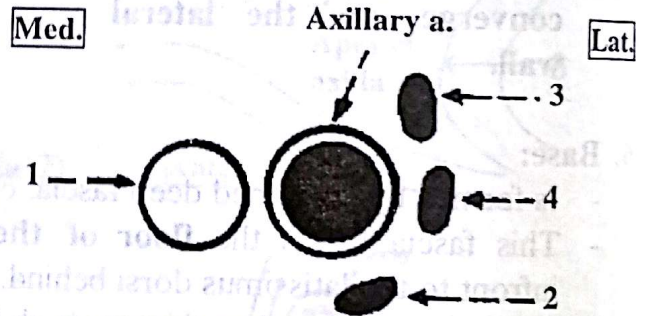


Relations:

Each part of the artery has its own relations, as follows:

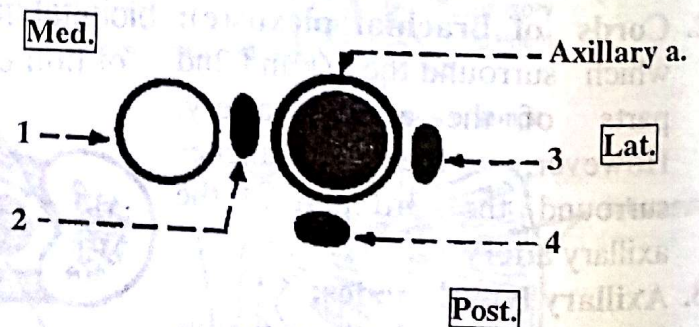
A. RELATIONS OF 1st PART:

- **Anteriorly:**
 - Clavicular head of pectoralis major.
 - Clavi-pectoral fascia.
- **Medially:**
 - Axillary vein(1).
- **Posteriorly:**
 - 1st digitation of serratus anterior.
 - Medial cord of brachial plexus(2) separating the artery from the serratus anterior.
- **Above and lateral:**
 - The lateral cord (above)(3).
 - The posterior cord (lateral)(4).



B. RELATIONS OF 2nd PART:

- **Anteriorly:**
 - Pectoralis major.
 - Pectoralis minor.
- **Medially:**
 - The medial cord(2), separating the artery from the axillary vein(1).
- **Laterally:**
 - The lateral cord(3), separating the artery from the coracobrachialis.
- **Posteriorly:**
 - The posterior cord(4), separating the artery from the subscapularis.



Note: the arrangement of the 3 cords around the 2nd part of the artery according to their names, i.e. the lateral cord is lateral, the medial cord is medial and the posterior cord is posterior to the artery.

C. RELATIONS OF 3rd PART:

It differs from the other 2 parts in 2 main features:

1. It is superficial and its lower 1/2 can be felt pulsating under the skin.
2. It is surrounded by the branches of the 3 cords.

• Anteriorly:

- Upper 1/2: pectoralis major.
- Lower 1/2: only skin and fascia.

• Medially:

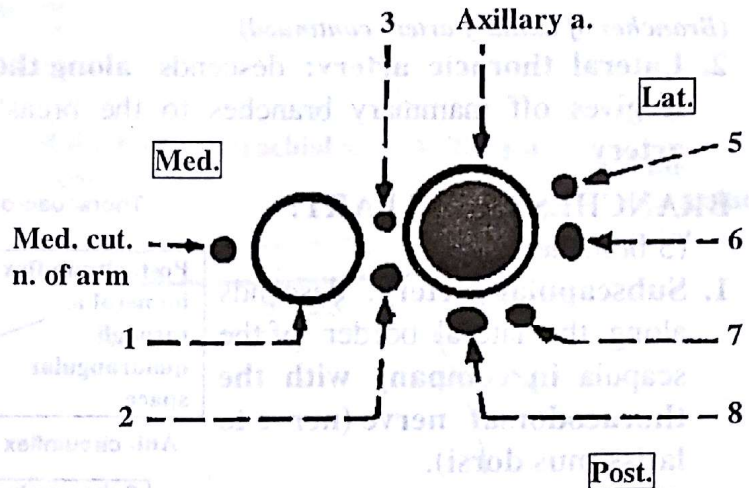
- Axillary vein(1).
- 2 nerves [ulnar(2) and medial cutaneous nerve of forearm(3)]: separating the artery from the axillary vein(1).

• Laterally:

- Musculo-cutaneous nerve(5).
- Median nerve(6).

• Posteriorly:

- Axillary nerve(7): separating the artery from the subscapularis.
- Radial nerve(8): separating the artery from the insertions of latissimus dorsi and teres major.

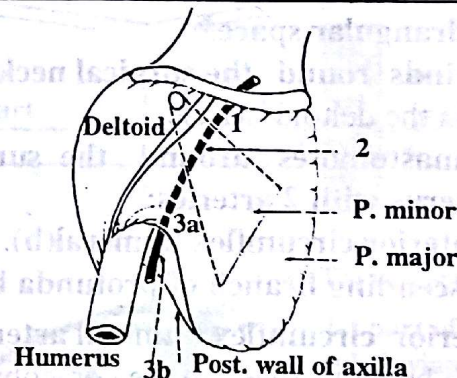


Summary for the anterior relations of the 3 parts of the axillary artery

1st part(1): clavicular head of P. major + clavipectoral fascia.

2nd part(2): pectoralis major + minor.

3rd part(3): Upper part(3a) covered by P. major.
Lower part(3b) covered only by skin and fascia only.



BRANCHES OF AXILLARY ARTERY

BRANCHES OF 1st PART: (one branch)

Superior thoracic artery: is a small branch that ramifies on the upper part of the lateral wall of the chest.

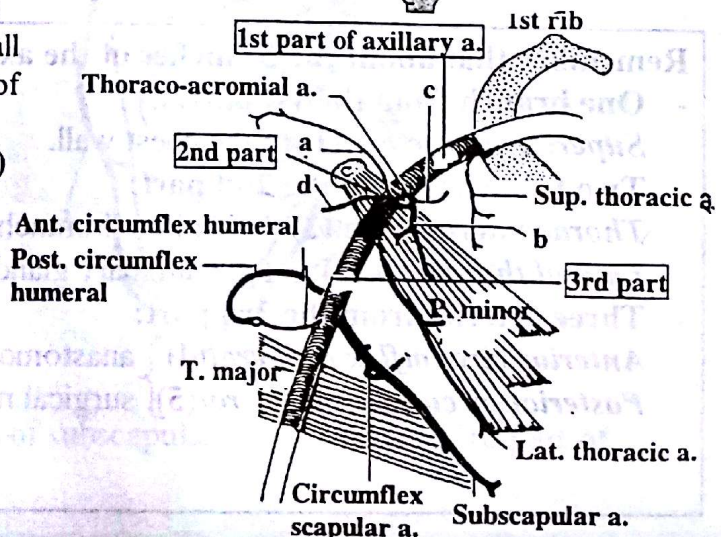
BRANCHES OF 2nd PART: (2 branches)

1. Thoraco-acromial artery: appears at the upper border of pectoralis minor and pierces the clavipectoral fascia.

It ends by giving off 4 branches

(a, p, c, d) as follows:

a. acromial: to the acromion.



- b. **pectoral:** to pectoral muscles.
- c. **clavicular:** to the clavicle.
- d. **deltoid:** to the region of deltoid (shoulder).

(Branches of axillary artery continued)

2. **Lateral thoracic artery:** descends along the lower border of pectoralis minor. It gives off mammary branches to the breast. It is called external mammary artery.

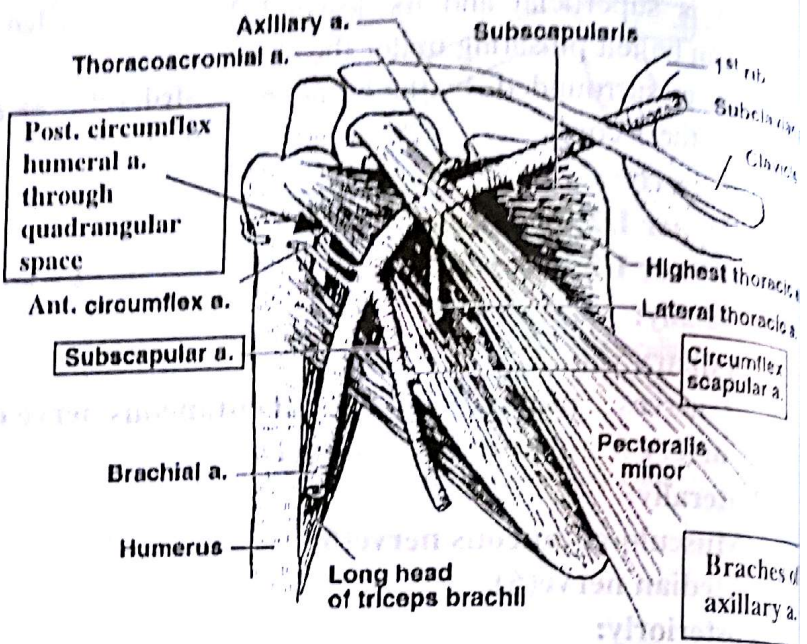
BRANCHES OF 3rd PART:

(3 branches).

1. **Subscapular artery:** descends along the lateral border of the scapula in company with the thoracodorsal nerve (nerve to latissimus dorsi).

Shortly-below its origin it gives off the **circumflex scapular branch** which winds round the lateral border of the scapula deep to the teres minor.

The continuation of the artery is called the thoracodorsal artery (along the thoracodorsal nerve).

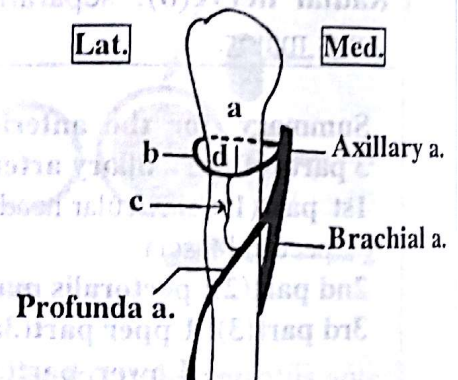


2. **Posterior circumflex humeral artery(a):** passes backwards with the axillary nerve through the quadrangular space.

It winds round the surgical neck of the humerus to end in the deltoid muscle.

It anastomoses around the surgical neck of the humerus with 2 arteries:

- i. **Anterior circumflex humeral(b).**
- ii. **Ascending branch of profunda brachii(c).**

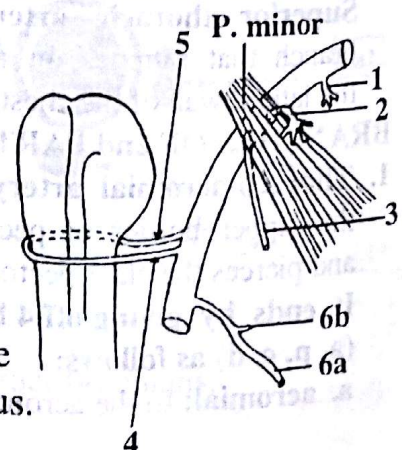


3. **Anterior circumflex humeral artery:** passes laterally in front of the surgical neck of the humerus (deep to the coracobrachialis).

It is smaller than the posterior circumflex and gives off an **ascending branch(d)** which ascends in the intertubercular-groove to join the anastomosis around the shoulder joint.

Remember that about the branches of the axillary artery

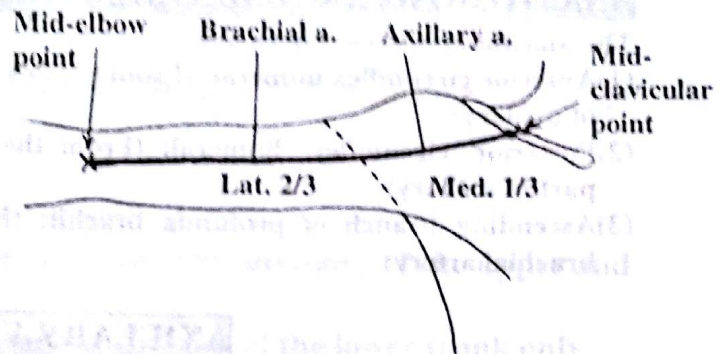
- **One branch from the 1st part:**
Superior thoracic a. (1) to the chest wall.
- **Two branches from the 2nd part:**
Thoraco-acromial a. (2) divide into 4 branches.
Lateral thoracic a. (3) to the mammary gland.
- **Three arteries from the 3rd part:**
Anterior circumflex humeral (4) } anastomoses around the
Posterior circumflex humeral (5) } surgical neck of humerus.



Subscapular(6a) and its branch **circumflex scapular(6b)** both share in the anastomoses around the scapula.

Surface anatomy of axillary artery:

- The arm is abducted to a right angle and then externally rotated so that the ventral surface is directed upwards.
- Drawn a line from the **mid-clavicular point** (middle of the clavicle) to the **mid-elbow point** (midway between the humeral epicondyles).
- The **medial 1/3** of this line is the **axillary artery**.
- The **lateral 2/3** is the **brachial artery**.



IMPORTANT ANASTOMOSES RELATED TO AXILLARY ARTERY:

1. Anastomosis around the scapula.
2. Anastomosis around the surgical neck of humerus.

ANASTOMOSIS AROUND THE SCAPULA:

This is a very efficient anastomosis between the **1st part** of the subclavian artery and the **3rd part** of the axillary artery.

The anastomosis occurs in the **infraspinous fossa** as follows:

- (1) **Suprascapular artery**: from thyro-cervical trunk of the 1st part of subclavian artery.

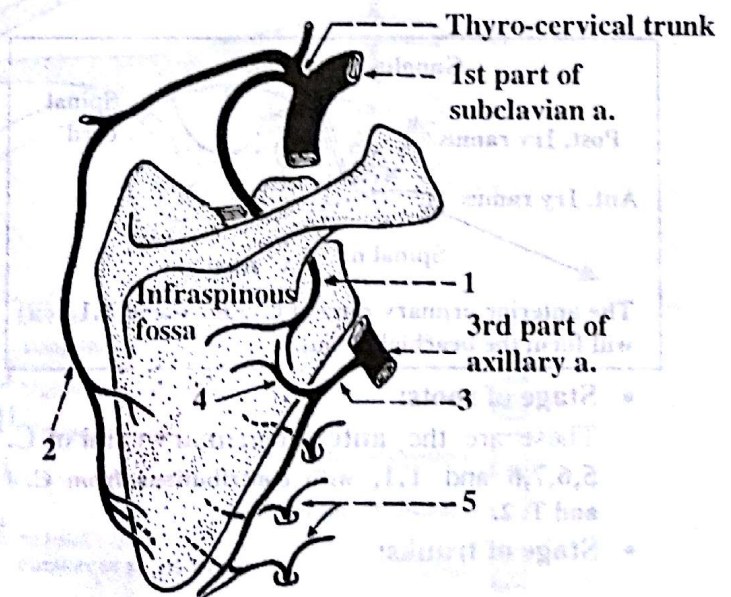
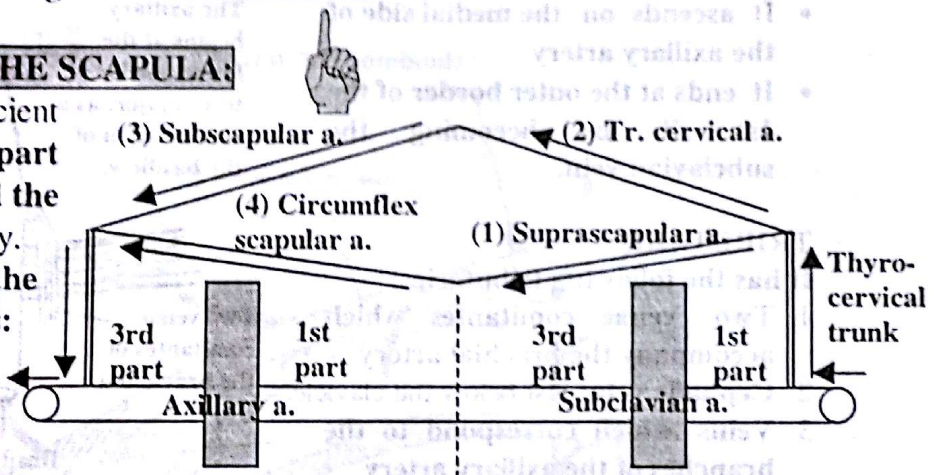
It reaches the upper border of the scapula and runs in the suprascapular and infraspinous fossae.

- (2) **Deep branch of transverse cervical artery (dorsal scapular)**: arises also from the thyro-cervical trunk of 1st part of subclavian artery.

It descends along the medial border of the scapula then joins the anastomosis in the infraspinous fossa.

- (3) **Subscapular artery**: from the 3rd part of the axillary artery and descends along the lateral border of the scapula and joins the anastomosis in the infraspinous fossa.

- (4) **Circumflex scapular artery**: (is a branch of subscapular artery from the 3rd part of axillary artery).



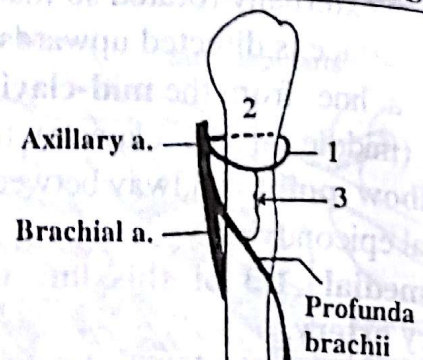
It crosses the lateral border of scapular to reach the infraspinous fossa and joins the anastomosis.

(5) Lateral branches of posterior intercostal arteries: they run in the intercostal spaces, and share in the anastomosis around scapula.

ANASTOMOSIS AROUND THE SURGICAL NECK OF THE HUMERUS:

The anastomosis occurs between:

- (1) Anterior circumflex humeral: (From the 3rd part of axillary).
- (2) Posterior circumflex humeral: (From the 3rd part of axillary).
- (3) Ascending branch of profunda brachii: (From brachial artery).



AXILLARY VEIN

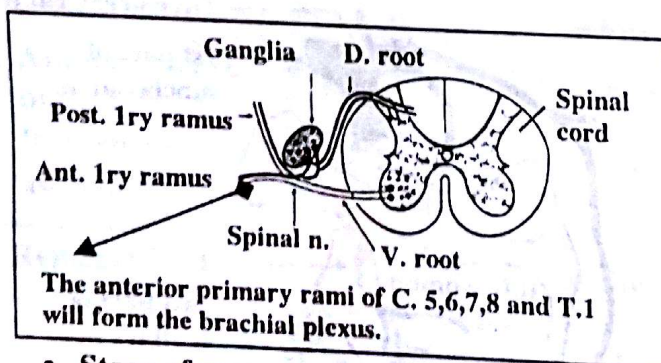
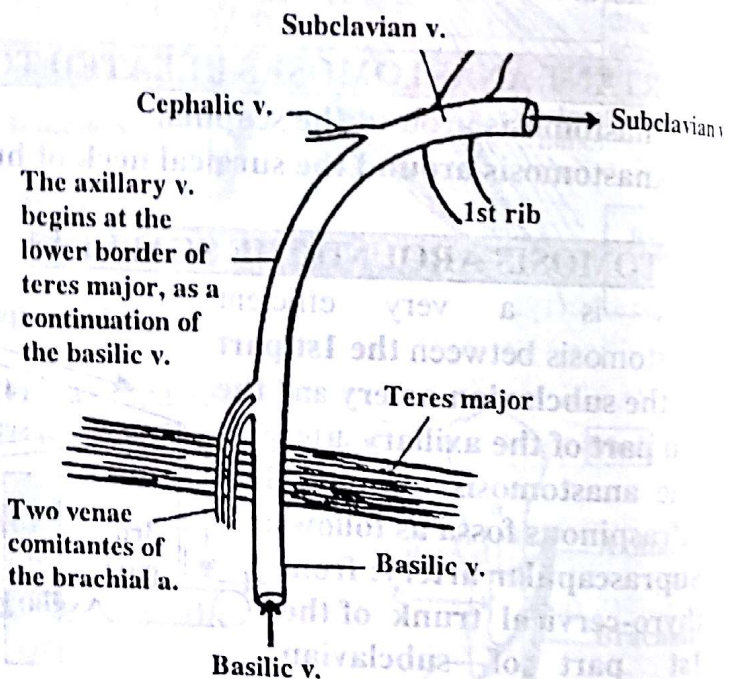
COURSE:

- It begins at the lower border of the teres major as a continuation of the basilic vein.
- It ascends on the medial side of the axillary artery.
- It ends at the outer border of the 1st rib by becoming the subclavian vein.

TRIBUTARIES:

It has the following tributaries:

1. Two venae comitantes which accompany the brachial artery.
2. Cephalic vein: just below the clavicle.
3. Veins which correspond to the branches of the axillary artery.



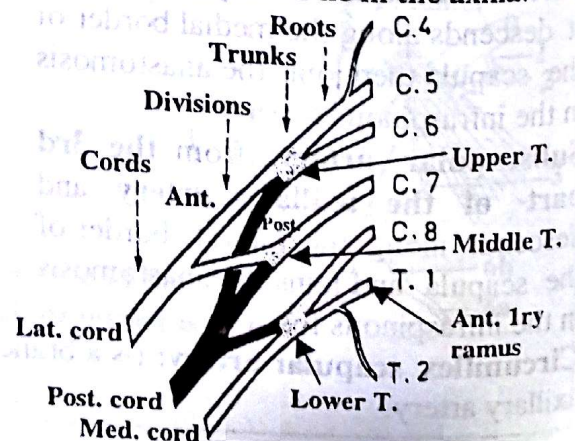
- **Stage of roots:**
These are the anterior primary rami of C. 5,6,7,8 and T.1, with contributions from C. 4 and T. 2.
- **Stage of trunks:**

BRACHIAL PLEXUS

FORMATION:

? It is composed of 4 stages:

- roots, trunks, divisions and cords.
- The roots and trunks lie in the neck.
- While the divisions lie behind the clavicle and the cords lie in the axilla.



These are the **upper, middle and lower trunks**, as follows:

- Upper trunk:** is formed by C. 5 and C. 6.
- Middle trunk:** is formed by C. 7.
- Lower trunk:** is formed by C. 8 and T. 1.

• **Stage of divisions:**

Each trunk divides into **anterior or ventral division** and **posterior or dorsal division**.

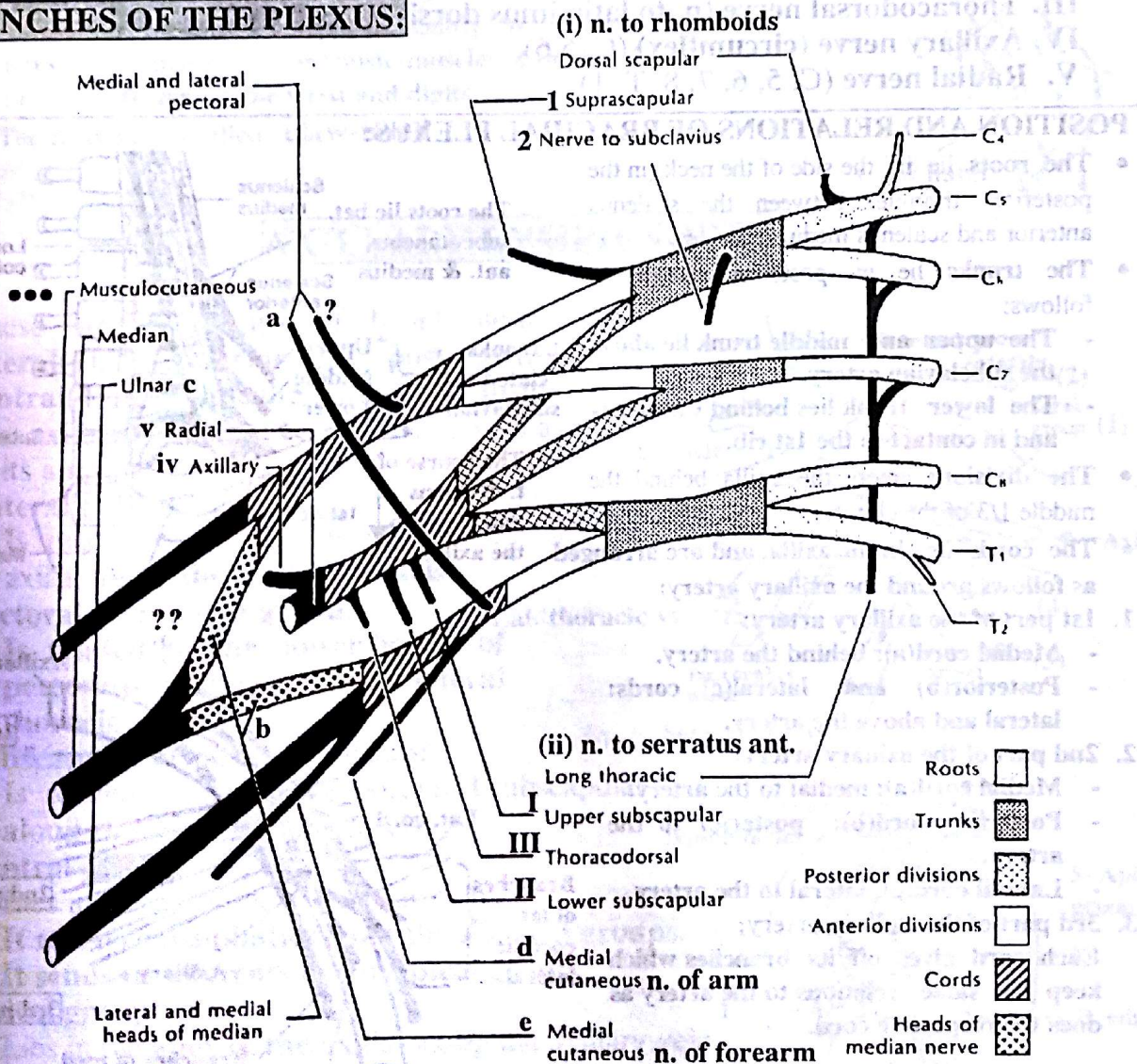
• **Stage of cords:**

These are the **lateral, medial and posterior cords**, as follows:

- **The lateral cord:** is formed by union of the **anterior divisions** of the **upper and middle trunks**.
- **The medial cord:** is formed by the **anterior division** of the **lower trunk** only.
- **The posterior cord:** is formed by union of the **posterior divisions** of the **3 trunks**.

Note that: The branches of lateral and medial cords supply the **anterior aspect** of the limb, while the posterior cord supplies its **posterior aspect**.

BRANCHES OF THE PLEXUS:



A. From the roots:

- Dorsal scapular nerve (n. to rhomboids) (C. 5).**

iii. A branch to the phrenic nerve from C. 5.

B. From the upper trunk: (C. 5,6)

1. Suprascapular nerve (C. 5,6).

2. Nerve to subclavius (C. 5,6).

(No branches arise from the middle and lower trunks)

C. From the cords:

• Lateral cord: 3 branches (C. 5,6,7)

• Lateral pectoral nerve (C. 5,6,7).

• Lateral root of median nerve (C. 5,6,7).

• Musculo-cutaneous nerve (C. 5,6,7).

• Medial cord: 5 branches (C. 8, T.1)

a. Medial pectoral nerve (C. 8, T.1).

b. Medial root of median nerve (C. 8, T.1).

c. Ulnar nerve (C. 8, T.1).

Note: that the ulnar nerve possesses fibers from C. 7,8 and T. 1. The fibers of C.7 come from the median nerve and join the ulnar nerve in the axilla or in the forearm.

d. Medial cutaneous nerve of arm (C. 8, T.1).

e. Medial cutaneous nerve of forearm (C. 8, T.1).

• Posterior cord: 5 branches (C. 5, 6, 7, 8, T. 1)

I. Upper subscapular nerve (C. 5,6).

II. Lower subscapular nerves (C. 5,6).

III. Thoracodorsal nerve (n. to latissimus dorsi) (C. 6,7, 8).

IV. Axillary nerve (circumflex) (C. 5,6).

V. Radial nerve (C. 5, 6, 7, 8, T. 1).

POSITION AND RELATIONS OF BRACHIAL PLEXUS:

• The roots lie in the side of the neck (in the posterior triangle) between the scalenus anterior and scalenus medius muscles.

• The trunks lie in posterior triangle, as follows:

- The upper and middle trunk lie above the subclavian artery.
- The lower trunk lies behind the artery and in contact to the 1st rib.

• The divisions enter the axilla behind the middle 1/3 of the clavicle.

• The cords lie in the axilla, and are arranged as follows around the axillary artery:

1. 1st part of the axillary artery:

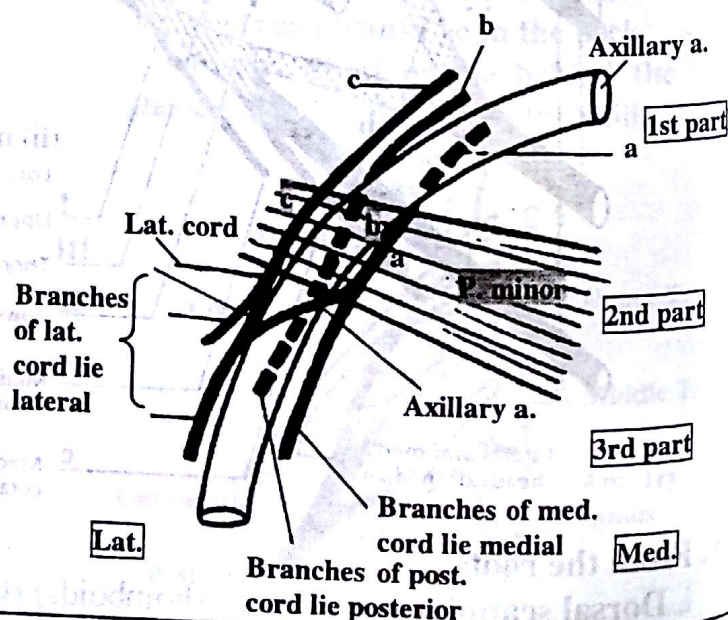
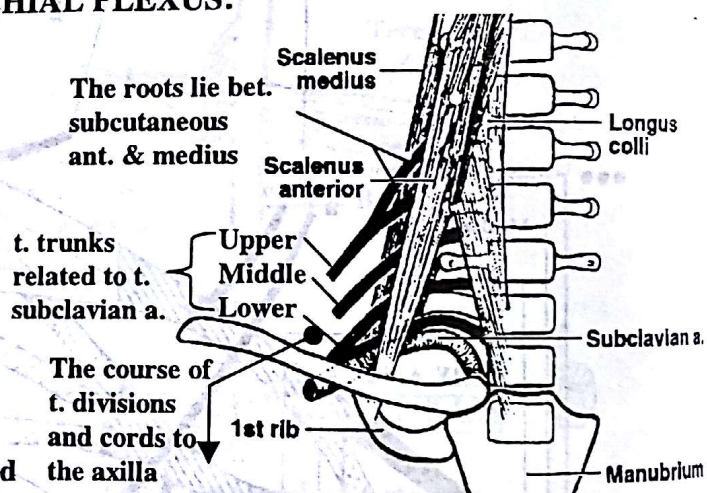
- Medial cord(a): behind the artery.
- Posterior(b) and lateral(c) cords: lateral and above the artery.

2. 2nd part of the axillary artery:

- Medial cord(a): medial to the artery.
- Posterior cord(b): posterior to the artery.
- Lateral cord(c): lateral to the artery.

3. 3rd part of the axillary artery:

Each cord gives off its branches which keep the same relations to the artery as does the respective cord.



The branches of medial cord are medial.
 The branches of lateral cord are lateral.
 The branches of posterior cord are posterior.

COMMON INJURIES OF BRACHIAL PLEXUS:



1. Erb's paralysis:

- This paralysis is due to a lesion to the upper trunk (C. 5, 6), which occurs during difficult labour.

All muscles supplied by C. 5,6 will be paralyzed, as follows:

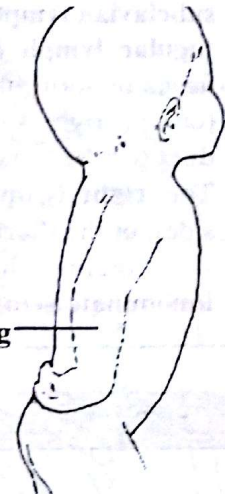
- **Deltoid:** › failure of abduction of the shoulder.
- **Infraspinatus:** › weakening of lateral rotation of the arm.
- **Biceps and brachialis:** › failure of flexion of the elbow.
- **Supinator:** › failure of supination of the forearm.

- Thus the upper limb is deformed in the following way:

1. The arm is medially rotated and cannot be abducted.
2. The forearm is extended and pronated.

This deformity is called (tip taking position).

Tip taking position



2. Klumpke's paralysis:

- This is due to a lesion to the lower trunk (C. 8, T. 1).
- All the muscles supplied by C. 8 and T. 1 are paralyzed.
- These are the muscles supplied mainly by the ulnar nerve and include the intrinsic-muscles of the hand and some flexors of the wrist and digits.
- The deformity is called **claw-hand**.

Claw hand



AXILLARY LYMPH NODES

These are 5 groups of lymph nodes: lateral(1), anterior(2), posterior(3), central(4) and apical(5) which lie inside the axilla in relation to its walls as well as to its apex.

1. Lateral group:

- Is related to the lateral wall of the axilla, along the axillary vessels.

2. Pectoral or anterior group:

- Is related to the lower border of pectoralis minor, along the lateral thoracic vessels.

3. Subscapular or posterior group:

- Is related to the lower border of subscapular along the subscapular vessels.

4. Central group:

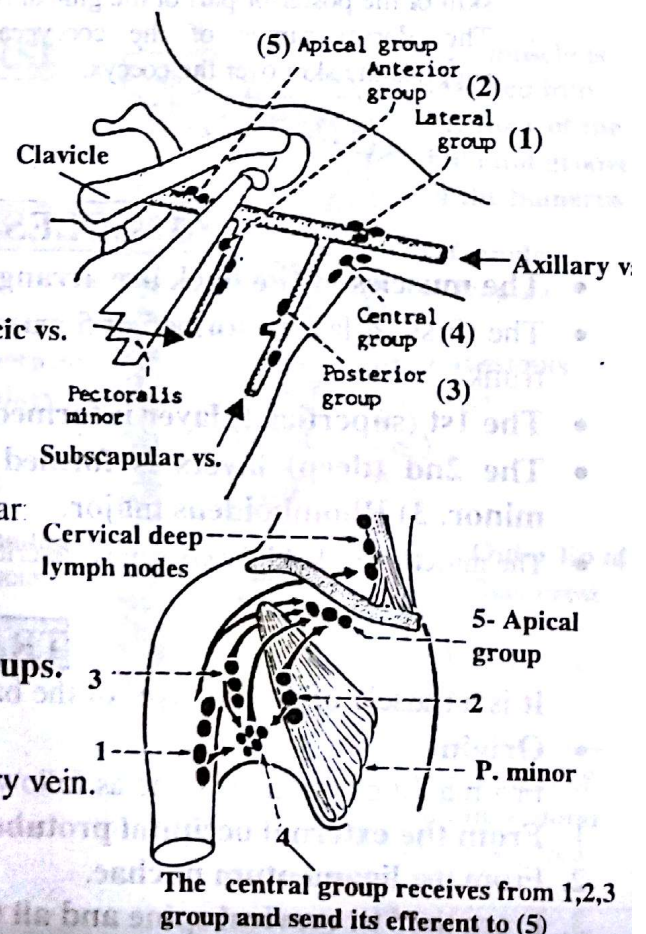
- Lies in the fat of the axilla near its base.
- It receives lymphatics from the above 3 groups.
- It sends its efferents to the apical group.

5. Apical group:

- Lies in the apex of the axilla, along the axillary vein.

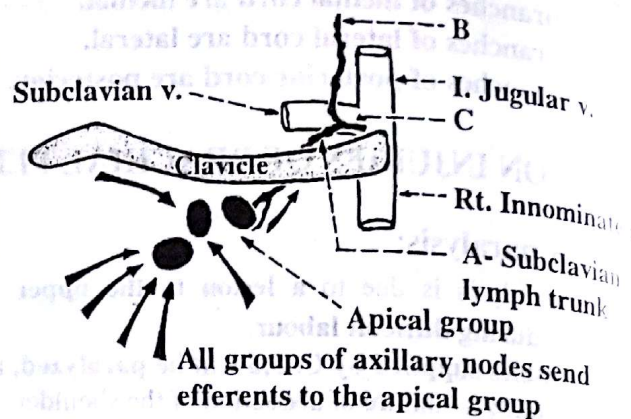
It receives afferent lymphatics from:

- a. All other axillary nodes.
- b. Upper part of the breast (direct lymphatics).



Remember that:

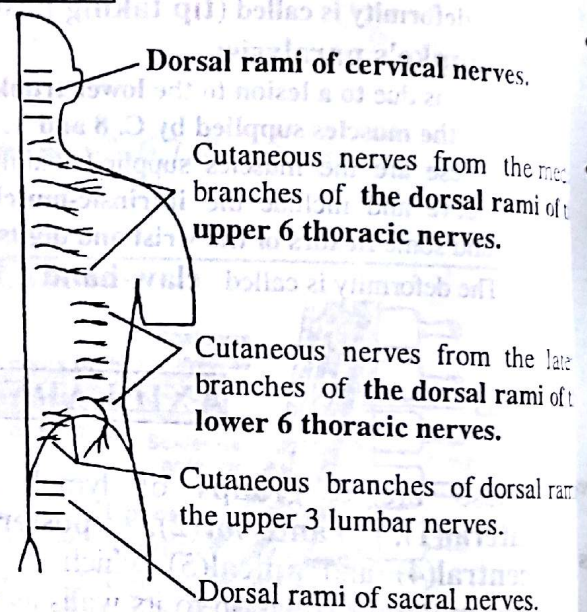
- The efferents of the apical group of lymph nodes collect in a lymphatic trunk called subclavian lymph trunk(A) which joins the jugular lymph trunk(B) in the root of the neck, to form the right lymphatic duct(C) (on the right side) or to end in the thoracic duct (on the left side).
- The right lymphatic duct (on the right side), or the thoracic duct (on the left side) drains into the corresponding innominate vein.



THE BACK

CUTANEOUS NERVES

- The back of the neck is supplied by the dorsal rami of the cervical nerves, except the first which has no cutaneous branches.
- The back of the trunk is supplied by the cutaneous branches of the dorsal rami of all thoracic, upper 3 lumbar and upper 3 sacral nerves.
- The cutaneous branches of the upper 3 lumbar and upper 3 sacral of the rami also supply the skin of the posterior part of the gluteal region.
- The dorsal ramus of the coccygeal nerve supplies the skin over the coccyx.



MUSCLES OF THE BACK:

- The muscles of the back are arranged in 4 layers.
- The first 2 layers formed of 5 muscles which connect the upper limb to the back of trunk.
- The 1st (superficial) layer is formed of: 1) Trapezius & 2) Latissimus dorsi.
- The 2nd (deep) layers is formed of: 1) Levator scapulae, 2) Rhomboideus minor, 3) Rhomboideus major.
- The muscles 3rd & 4th layers will be described in head and neck.

TRAPEZIUS

It is a muscle of the 1st layer of the back.

• Origin:

From a long continuous line as follows (from above downwards):

1. From the external occipital protuberance and medial 1/3 of the superior nuchal line.
2. From the ligamentum nuchae.
3. From the 7th cervical spine and all the 12 thoracic spines.

• **Insertion:**

(1) **Upper**

fibers: are inserted into the **posterior border of the lateral 1/3 of the clavicle.**

(2) **Middle fibers:** are inserted into the **medial border of the acromion and upper lip of the crest of the spine of the scapula.**

(3) **Lower fibers:** are inserted into the **medial part of the crest of the spine of the scapula** (in a tubercle near the root of the spine).

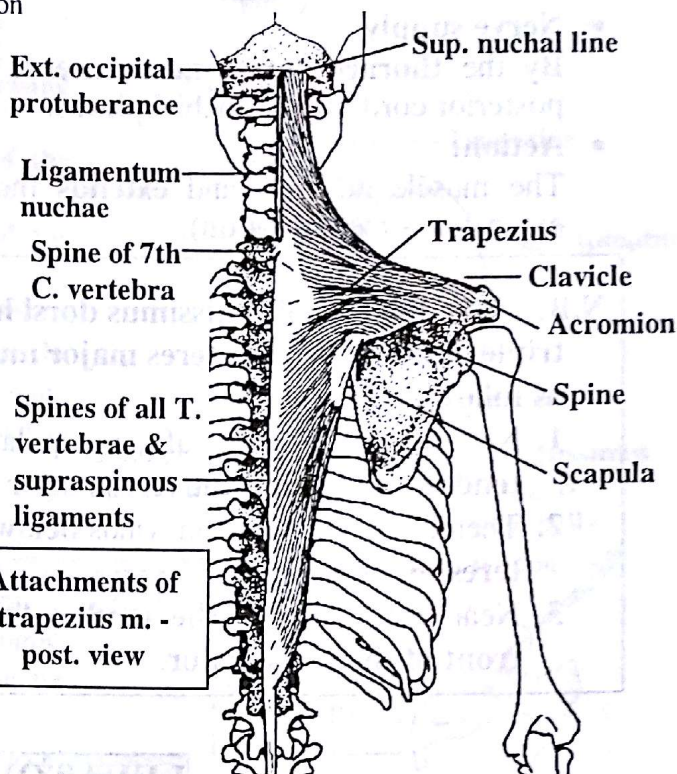
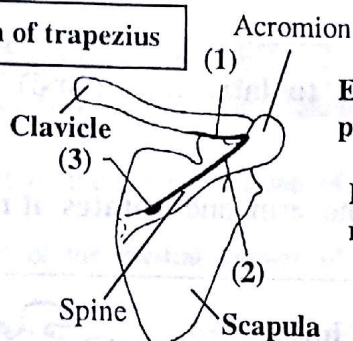
• **Nerve supply:**

1. Spinal root of **accessory nerve.**
2. The **3rd and 4th cervical nerves** (proprioceptive).

• **Action:**

1. **Upper fibers:** rotate the scapula upwards and **elevate the shoulder.**
2. **Middle fibers:** **retract** the scapula (draw it towards the vertebral column).
This braces the shoulder backwards!
3. **Lower fibers:** **depress** the scapula and **shoulder.**
4. **Middle and lower fibers:** help serratus anterior to rotate the scapula forwards around the chest to raise the arm above the head (**in abduction of the arm more than 90**).

Insertion of trapezius



LATISSIMUS DORSI

It lies in the lower part of the back (1st layer of muscles together with the trapezius).

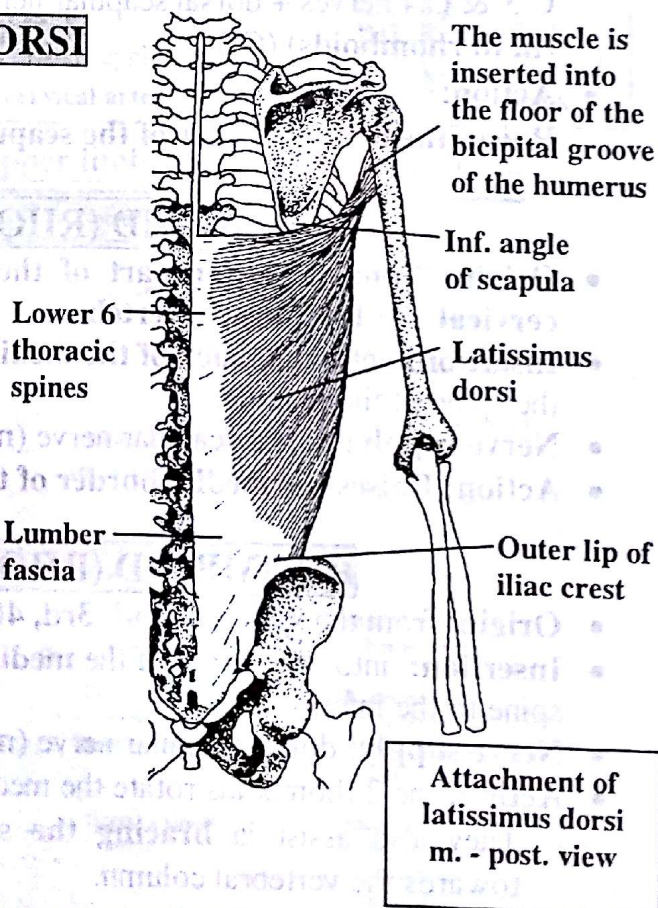
It is a muscle with a wide origin but with a narrow insertion.

• **Origin: from:**

- (1) **Lower 6 thoracic spines.**
- (2) **Thoraco-lumbar fascia** (strong fascia of the back).
- (3) **Back of the inferior angle of the scapula** (small slip).
- (4) **Lower 4 ribs.**
- (5) **Posterior part of the outer lip of the iliac crest.**

• **Insertion:**

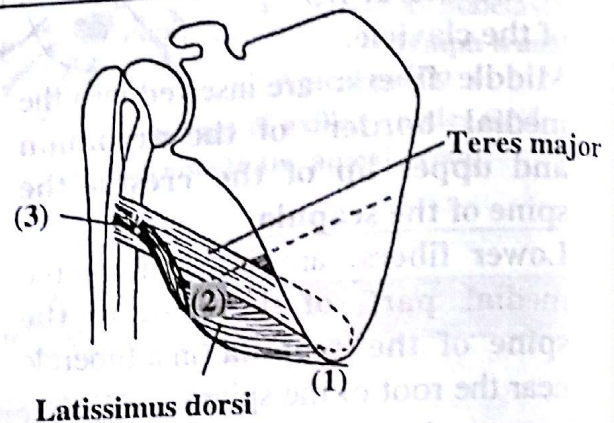
The fibers are directed upwards and laterally to end in a narrow tendon which is **inserted into the floor of the intertubercular (bicipital) groove.**



- **Nerve supply:**
By the **thoraco-dorsal nerve** (nerve to latissimus dorsi) (C. 6, 7, 8), from the posterior cord of the brachial plexus.
- **Action:**
The muscle **adducts** and **extends** the arm and **rotates it medially**. (Adduction, extension + med. rotation).

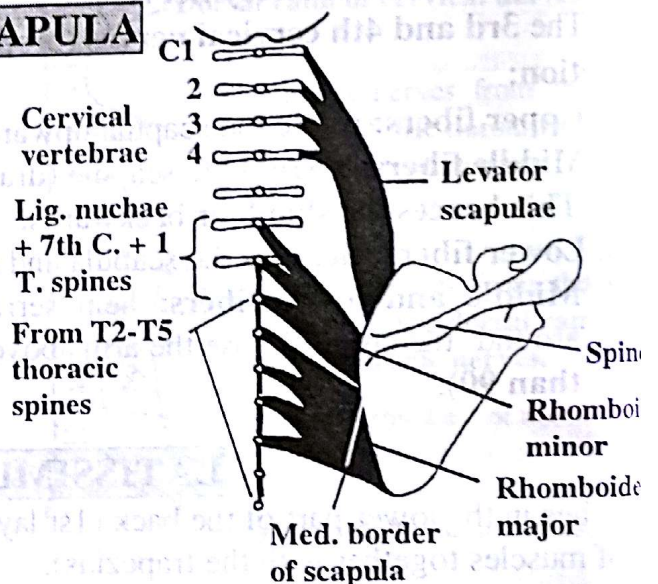
N.B.: The tendon of latissimus dorsi has a **triple relation to the teres major muscle** as follows:

1. Near the inferior angle of the scapula, the **tendon lies behind the teres major**.
2. Thereafter, the tendon winds **below the teres major**.
3. Near the humerus, the **tendon lies in front of the teres major**.



LEVATOR SCAPULAE

- **Origin:**
From the transverse process of the **upper 4 cervical vertebrae**.
- **Insertion:**
Into the **back of the medial border of the scapula** from the superior angle to the root of the spine.
- **Nerve supply:**
C.3 & C.4 nerves + dorsal scapular nerve (n. to rhomboids) (C.5).
- **Action:**
Raises the medial border of the scapula.



RHOMBOID (RHOMBOIDEUS) MINOR

- **Origin:** from the lower part of the ligamentum nuchae and spines of the 7th cervical and 1st thoracic vertebrae.
- **Insertion:** into the **back of the medial border of the scapula** opposite the root of the spine of the scapula.
- **Nerve supply:** dorsal scapular nerve (n. to rhomboids) C.5.
- **Action:** **Raises the medial border of the scapula upward and medially.**

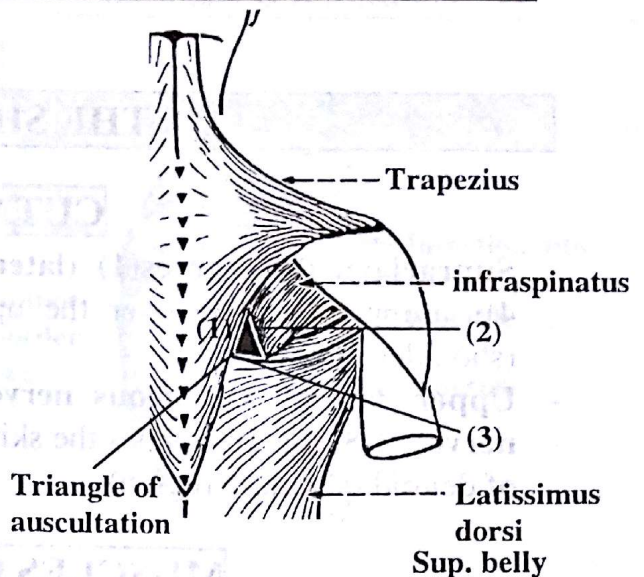
RHOMBOID (RHOMBOIDEUS) MAJOR

- **Origin:** from the spines of 2nd, 3rd, 4th, 5th thoracic vertebrae.
- **Insertion:** into the **back of the medial border of the scapula** from the root of the spine to the inferior angle.
- **Nerve supply:** dorsal scapular nerve (n. to rhomboids C.5).
- **Action:** the 2 rhomboids rotate the medial border of scapula upwards and medially.
 - They also assist in **bracing the shoulder backwards**, i.e. draw the scapula towards the vertebral column.

TRIANGLE OF AUSCULTATION

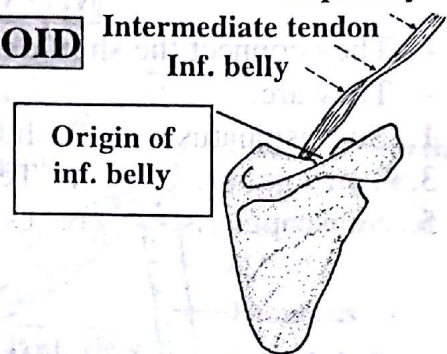


- It is a triangle in the back, having the following boundaries:
 - Medially:** lower part of the lateral border of the trapezius(1).
 - Laterally:** lower part of the medial border of the scapula(2).
 - Below(3):** upper free border of the latissimus dorsi.
- Its floor is formed only by the rhomboideus major muscle, and accordingly breath sounds inside the lung are more clearly auscultated (heard), hence the name "triangle of auscultation".



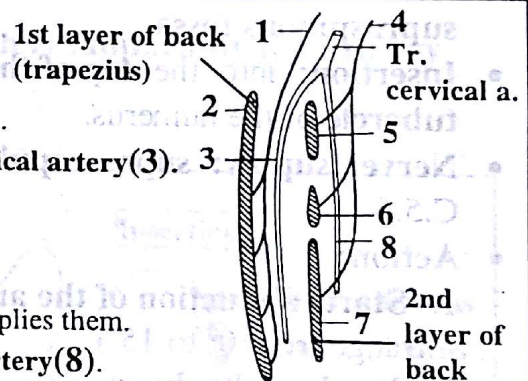
INFERIOR BELLY OF OMOHYOID

- Origin:** is a slender muscle which arises from the upper border of the scapula, very close to the suprascapular notch.
- Insertion:** into the intermediate tendon (lies in the neck), which gives origin to the superior belly of the muscle.
- Nerve supply:** from the ansa cervicalis (C.1, 2, 3) in the neck.
- Action:** depresses the hyoid bone (a small bone in the front of neck).



Remember that about:

- Accessory nerve(1) (spinal root)**
 - It passes downwards deep to the trapezius(2) muscle and supplies it.
 - It is accompanied by the superficial branch of the transverse cervical artery(3).
 - (It will be described with the nerves of the head and neck).
- Dorsal scapular nerve(4) (n. to rhomboid)**
 - It arises from C.5 nerve root of the brachial plexus.
 - It descends deep to levator(5) and rhomboid muscles(6,7) and supplies them.
 - It is accompanied by the deep branch of the transverse cervical artery(8).



Summary for the muscles connecting the upper limb to the vertebral column

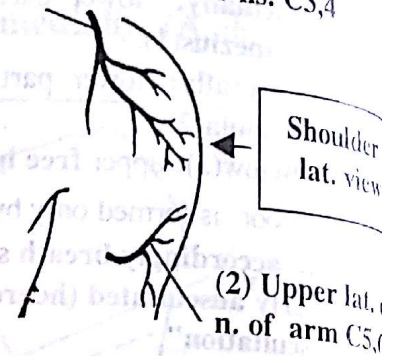
Name of Muscle	Origin	Insertion	Nerve Supply	Action
Trapezius	Occipital bone, ligamentum nuchae, spine of seventh cervical vertebra, spines of all thoracic vertebrae	Upper fibers into lateral third of clavicle; middle and lower fibers into acromion and spine of scapula	Accessory nerve and C3 and 4	Upper fibers elevate the scapula; middle fibers pull scapula medially; lower fibers pull medial border of scapula downward
Latissimus dorsi	Iliac crest, lumbar fascia, spines of lower six thoracic vertebrae, lower three or four ribs, and inferior angle of scapula	Floor of bicipital groove of humerus	Thoracodorsal nerve (n. to latissimus dorsi)	Extends, adducts, and medially rotates the arm
Levator scapulae	Transverse processes of first four cervical vertebrae	Medial border of scapula	C3 and 4 and dorsal scapular nerve	Raises medial border of scapula
Rhomboid minor	Ligamentum nuchae and spines of seventh cervical and first thoracic vertebrae	Medial border of scapula	Dorsal scapular nerve (n. to rhomboid)	Raises medial border of scapula upward and medially
Rhomboid major	Second to fifth thoracic spines	Medial border of scapula	Dorsal scapular nerve	Raises medial border of scapula upward and medially

THE SHOULDER REGION

CUTANEOUS NERVE

- **Supraclavicular nerves(1) (lateral branches) (C3, 4):** supply the skin over the upper 1/2 of deltoid (shoulder region).
- **Upper lateral cutaneous nerve of arm (axillary nerve) (C5, 6):(2)** supplies the skin over the lower 1/2 of deltoid (shoulder region).

(1) Supra-clavicular ns. C3,4



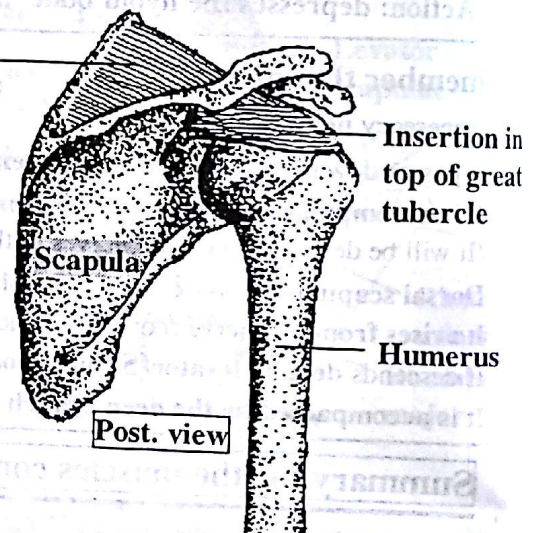
MUSCLES OF THE SHOULDER

- They connect the **shoulder (pectoral) girdle** (clavicle + scapula) with the humerus.
- They are:
 1. Supraspinatus.
 2. Infraspinatus.
 3. Teres minor.
 4. Terse major.
 5. Subscapularis.
 6. Deltoid.

SUPRASPINATUS

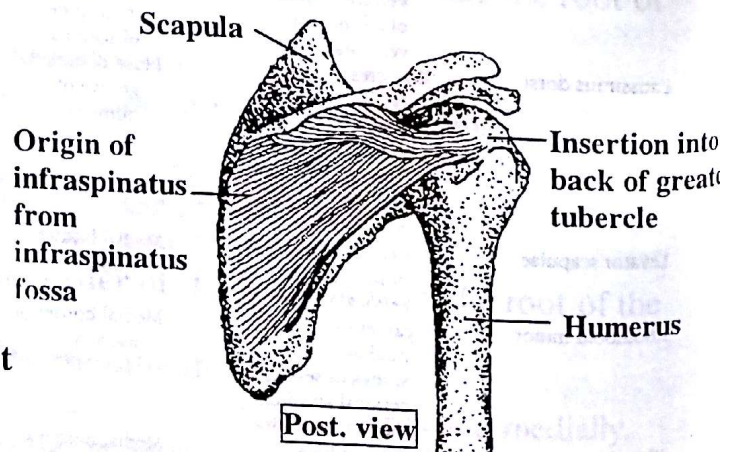
- **Origin:** from the medial 2/3 of the supraspinous fossa.
- **Insertion:** into the top of the greater tubercle of the humerus.
- **Nerve supply:** suprascapular nerve C.5,6.
- **Action:**
 1. Starts abduction of the arm (in the range from 0° to 15°).
 2. Steadies the head of the humerus in the glenoid cavity during abduction of the shoulder joint; being a part of the rotator muscle cuff.

Origin of
supraspinatus
from
supraspinatus
fossa



INFRASPINATUS

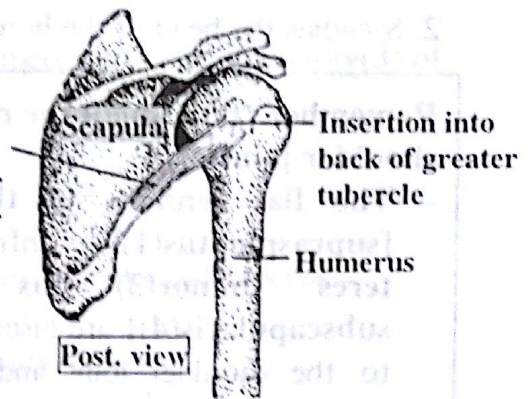
- **Origin:** from the medial 2/3 of the infraspinous fossa.
- **Insertion:** into the back of greater tubercle just below the supraspinatus.
- **Nerve supply:** suprascapular nerve.
- **Action:**
 1. Adducts the arm and rotates it laterally.
 2. Steadies the head of the humerus in the glenoid cavity.



TERES MINOR

- **Origin:** from the upper 2/3 of the back of lateral border of the scapula.
- **Insertion:** into the lower part of the greater tubercle.
- **Nerve supply:** axillary nerve.
- **Action:**
 1. Adducts the arm and rotates it laterally.
 2. Steadies the head of the humerus.

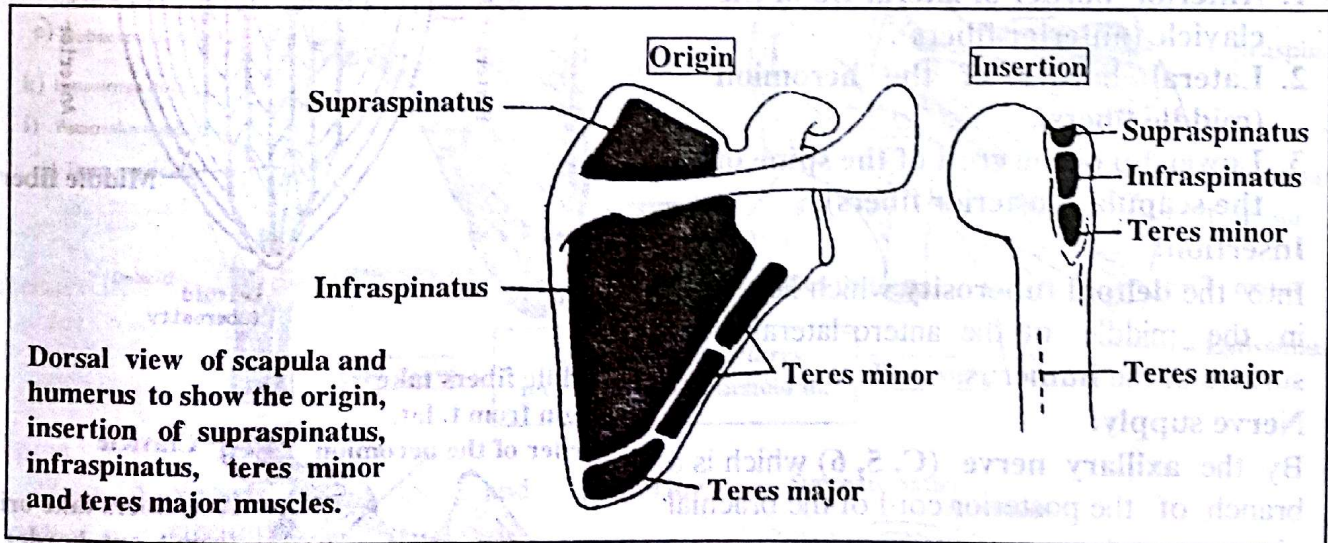
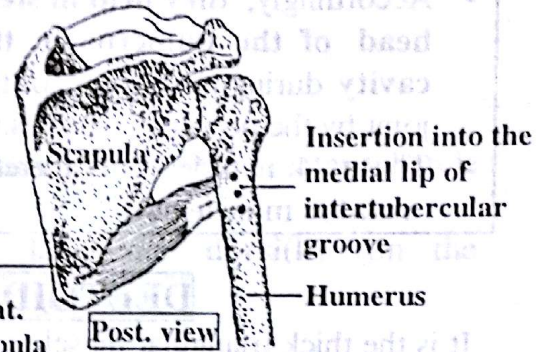
Origin of T. minor from upper 2/3 minor from lat. border of T. scapula



TERES MAJOR

- **Origin:** From the back of the inferior angle and adjoining 1/3 of the back of the lateral border of the scapula.
- **Insertion:** Into the medial lip of the intertubercular groove.
- **Nerve supply:** Lower subscapular nerve.
(Note: the differences from the teres minor which is supplied by the axillary nerve).
- **Action:** Adducts the arm and rotates it medially.

Origin of T. major from lower 1/3 of lat. border of scapula

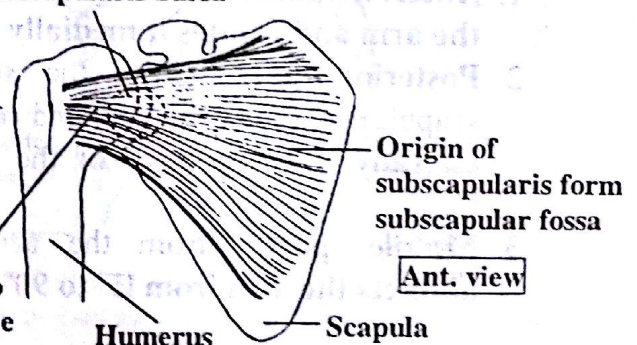


SUBSCAPULARIS

- **Origin:** from the medial 2/3 of the subscapular fossa.
- **Insertion:** into the lesser tubercle of the humerus.
The tendon is separated from the neck of the scapula by the subscapular bursa.
- **Nerve supply:** upper and lower subscapular nerves.

Subscapularis bursa

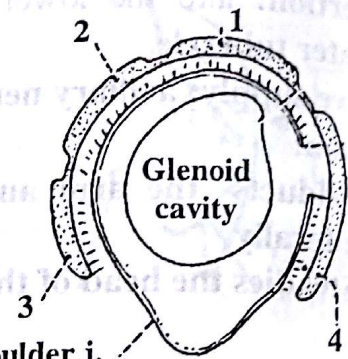
Insertion into lesser tubercle



- **Action:**
 1. Adducts the arm and rotates it medially.
 2. Steadies the head of the humerus.

Remember that about the rotator cuff of shoulder joint:

- The flat tendons of the 4 muscles [supraspinatus(1), infraspinatus(2), teres minor(3) as well as subscapularis(4)] are inserted very close to the shoulder joint and are blended with its capsule.
- Accordingly, they help in steadying the head of the humerus in the glenoid cavity during movements of the shoulder joint by the powerful muscles.
- These 4 muscles are, therefore, called **rotator muscle cuff**



Capsule of shoulder j.

The glenoid cavity of the scapula + part of capsule of the shoulder joint, showing the tendon of the 4 muscles which surround the joint and form the **rotator cuff** of the shoulder.

DELTOID MUSCLE

It is the thick triangular muscle of the shoulder. It consists of 3 parts: anterior, middle and posterior.

- **Origin:** from:

1. Anterior border of lateral 1/3 of the clavicle (anterior fibers).
2. Lateral border of the acromion (middle fibers).
3. Lower lip of the crest of the spine of the scapula (posterior fibers).

- **Insertion:**

Into the **deltoid tuberosity** which lies in the middle of the antero-lateral surface of the **humerus**.

- **Nerve supply:**

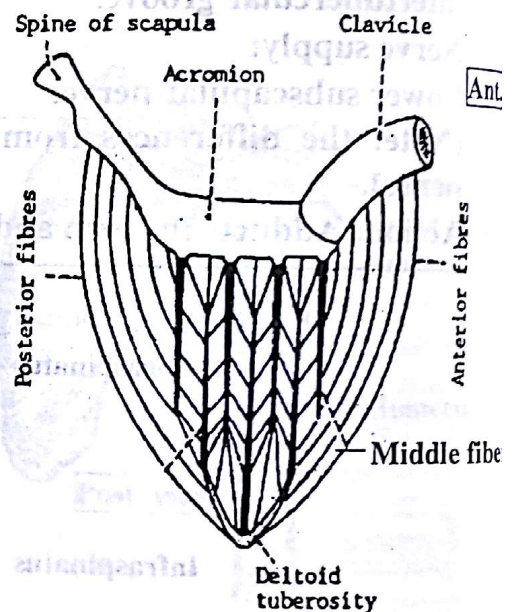
By the **axillary nerve** (C. 5, 6) which is a branch of the posterior cord of the brachial plexus.

- **Action:**

1. **Anterior part** (from the clavicle): flexes the arm and rotates it medially.
2. **Posterior part** (from the spine of scapula): extends the arm and rotates it laterally (the reverse of the anterior part).
3. **Middle part** (from the acromion): abducts the arm from 15° to 90°.



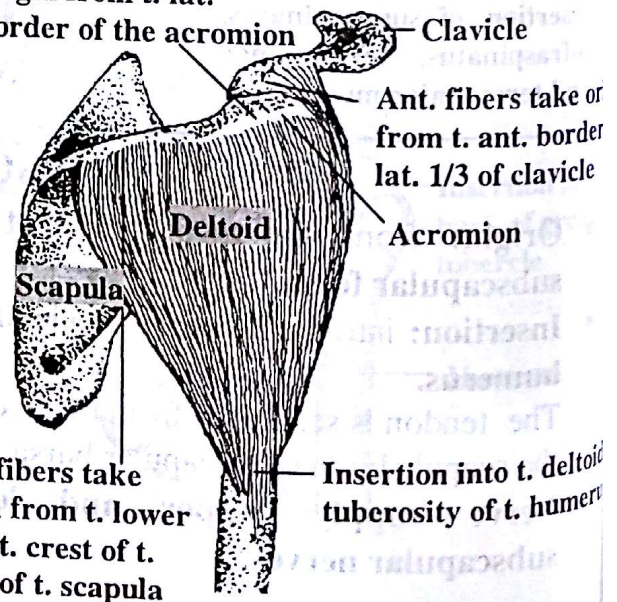
Post.



Middle fibers take origin from t. lat. border of the acromion

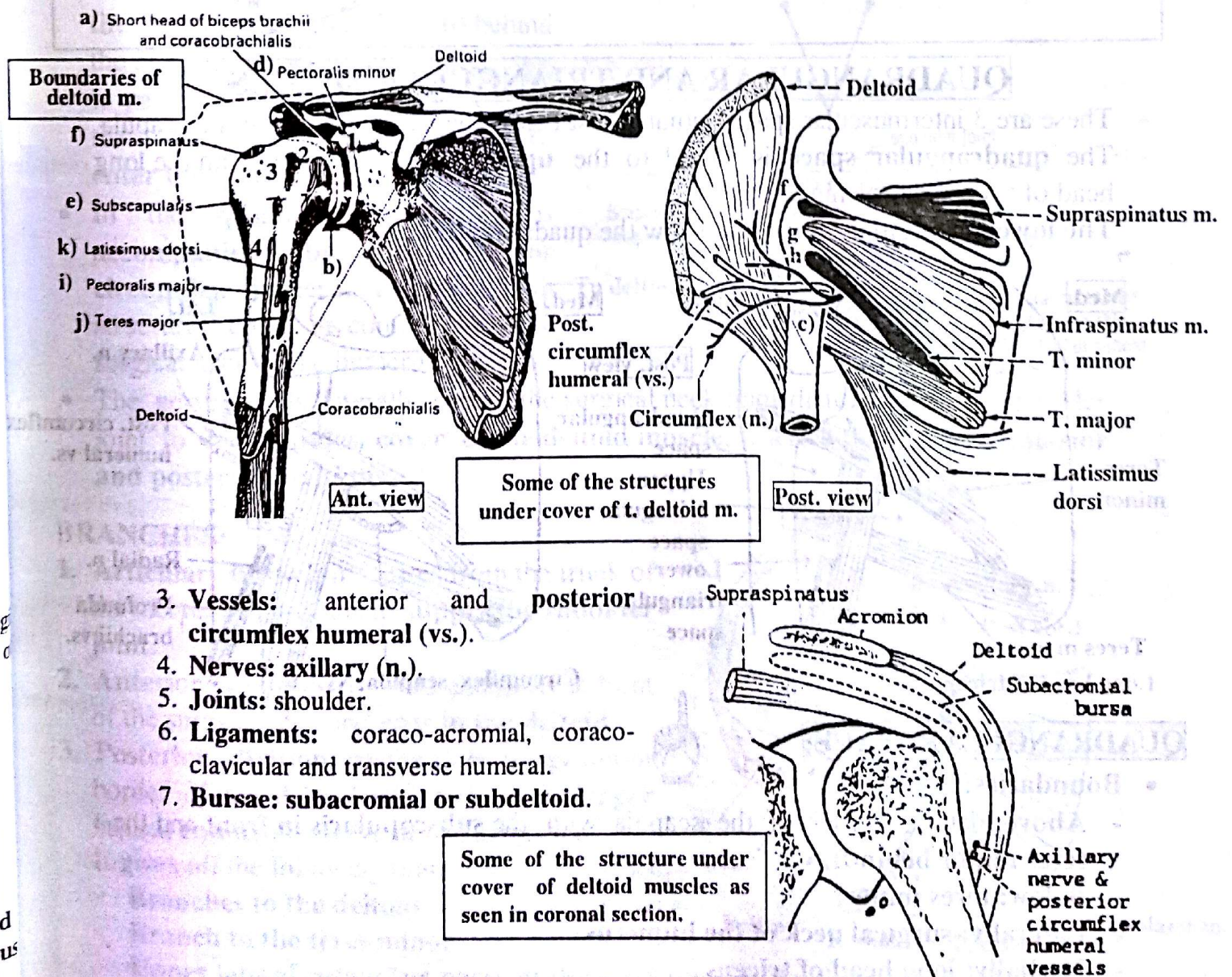
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Post.

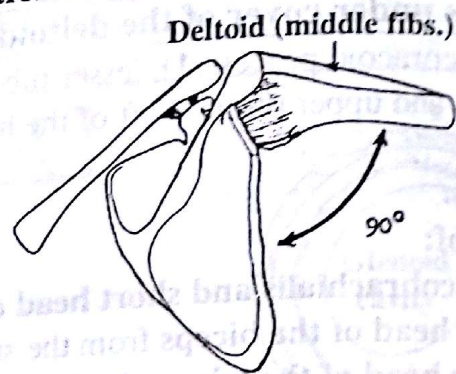
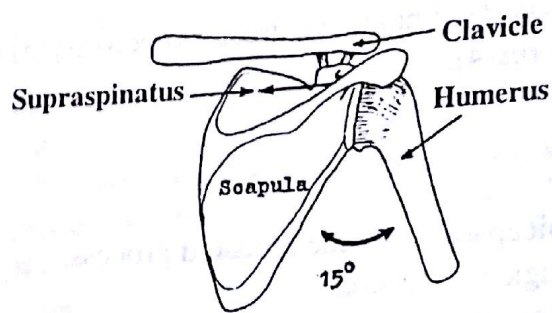


Structures under cover of the deltoid

1. **Bones:** coracoid process(1), lesser tuberosity(2) of humerus, greater tuberosity(3) of humerus and upper of the shaft of the humerus(4).
2. **Muscles:**
 - **Origin of:**
 - i. Coracobrachialis and short head of biceps(a) from the coracoid process.
 - ii. Long head of the biceps from the supraglenoid tubercle.
 - iii. Long head of the triceps(b) from the infraglenoid tubercle.
 - iv. The lateral head of the triceps(c) from the upper end of the humerus.
 - **Insertions of:**
 - i. Pectoralis minor(d) (on coracoid process).
 - ii. Subscapularis(e) (on lesser tubercle of humerus).
 - iii. Supraspinatus(f), infraspinatus(g) and teres minor(h) (on the greater tubercle of the humerus).
 - iv. Pectoralis major(i), teres major(j) and latissimus dorsi(k) (on the intertubercular sulcus of the humerus).
3. **Vessels:** anterior and posterior circumflex humeral (vs.).
4. **Nerves:** axillary (n.).
5. **Joints:** shoulder.
6. **Ligaments:** coraco-acromial, coraco-clavicular and transverse humeral.
7. **Bursae:** subacromial or subdeltoid.

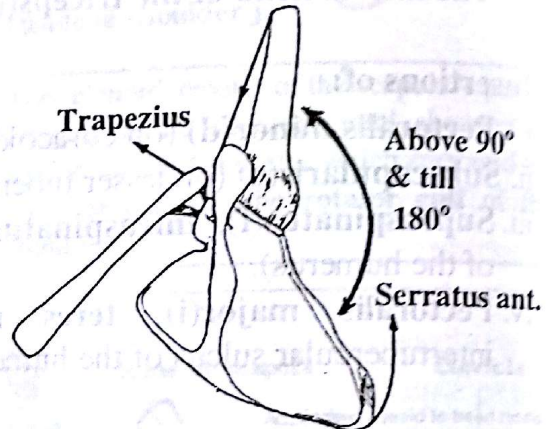


Upper Limb
What are the muscles producing abduction of the arm in degrees:



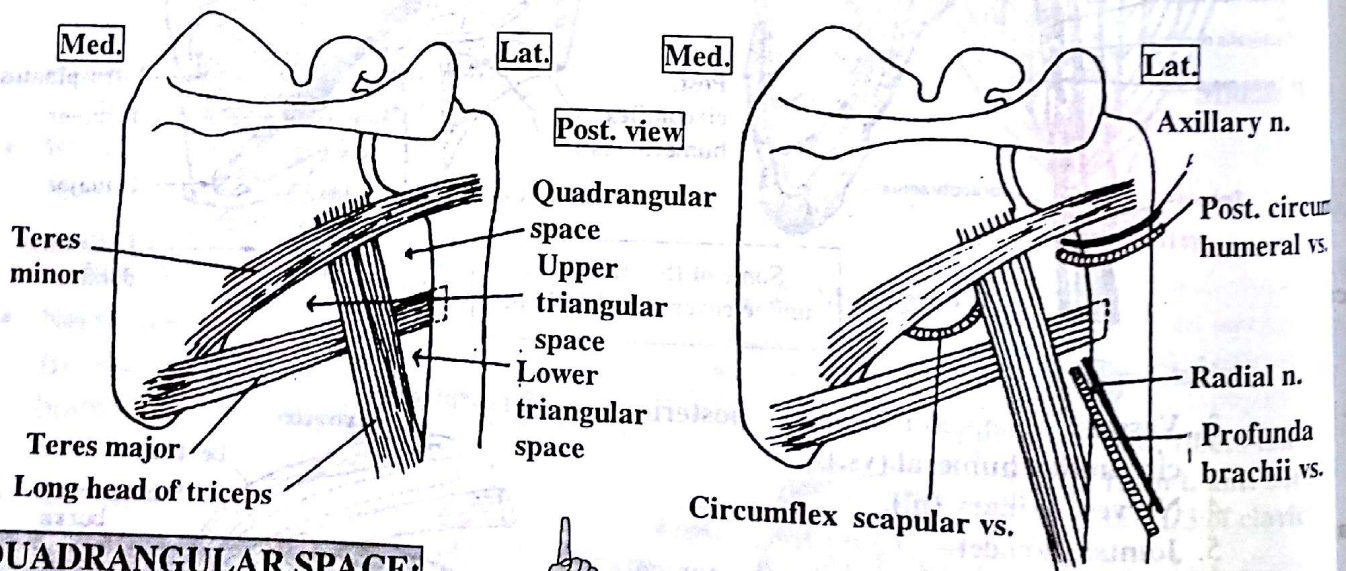
1. From zero > 15° = supraspinatus. 2. From 15° > 90° = middle fibers of deltoid.

3. From 90° > upwards is raising the arm above the head. This occurs through the rotation of the scapula by the action of trapezius and serratus anterior.



QUADRANGULAR AND TRIANGULAR SPACES

- These are 3 intermuscular spaces situated just below the lateral border of the scapula.
- The **quadrangular space** is lateral to the **upper triangular space** with the long head of triceps intervening.
- The **lower triangular space** lies below the quadrangular space.



QUADRANGULAR SPACE:

- **Boundaries:**
 - Above: lateral border of the scapula with the **subscapularis** in front and the **teres minor** behind.
 - Below: **teres major**.
 - Laterally: **surgical neck of the humerus**.
 - Medially: **long head of triceps**.
- **Contents:** 1. Axillary nerve. 2. Posterior circumflex humeral vessels.



UPPER TRIANGULAR SPACE:



- **Boundaries:**
 - Above: lateral border of the scapula with the **subscapularis in front** and the **teres minor behind**.
 - Below: **teres major**.
 - Laterally: **long head of triceps**.
- **Content:** **circumflex scapular branch of the subscapular artery**.

LOWER TRIANGULAR SPACE:

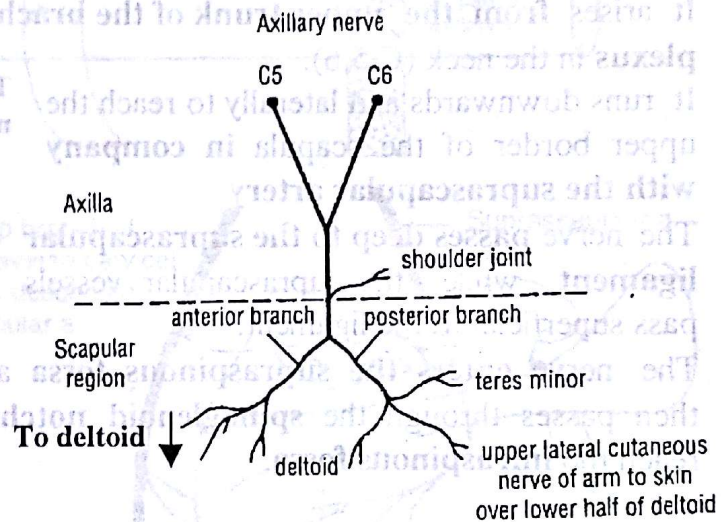
- **Boundaries:**
 - Medially: **long head of triceps**.
 - Laterally: **medial border of humerus**.
 - Superior **teres major**.
- **Contents:** 1. **Radial nerve**. 2. **Profunda brachii vessels**.

AXILLARY NERVE



COURSE AND RELATIONS:

- It arises from the **posterior cord of the brachial plexus (C. 5, 6)** behind the 3rd part of the axillary artery.
- It passes over the **subscapularis** and then curves backwards below it to **enter the quadrangular space**.
- In the quadrangular space, it is **accompanied by the posterior circumflex humeral vessels** and both structures come in contact with the **surgical neck of the humerus**.
- The nerve winds laterally round the surgical neck immediately below the shoulder joint to come **under cover of the deltoid muscle**, where it **divides into anterior and posterior divisions**.

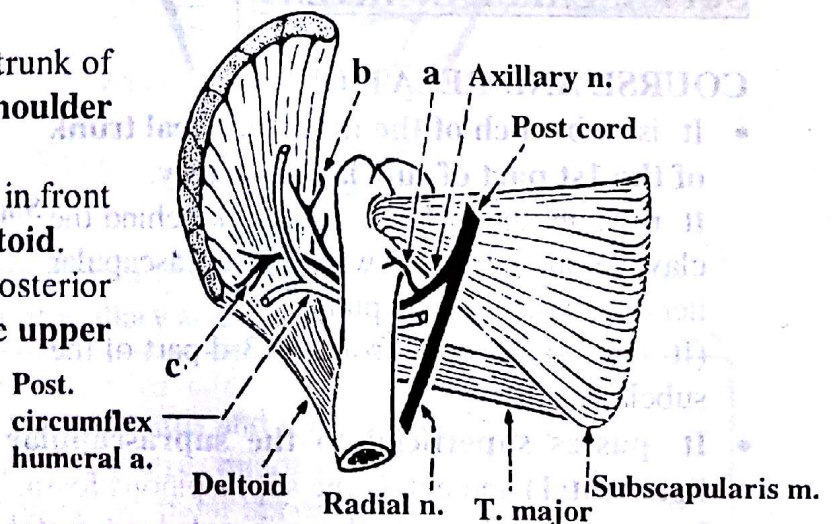


BRANCHES:

1. **Articular branch(a):** arises from the trunk of the nerve and ascends to **supply the shoulder joint**.
2. **Anterior division(b):** runs anteriorly in front of the surgical neck and ends **in the deltoid**.
3. **Posterior division:** passes along the posterior border of the deltoid and ends as the **upper lateral cutaneous nerve of the arm(c)**.

It gives off the following branches:

- **Branches to the deltoid.**
- **Branch to the teres minor.**
- **Upper lateral cutaneous nerve of the arm:** supplies the skin of the upper part of the lateral side of the arm (over the lower 1/2 of the deltoid).



EFFECT OF INJURY:

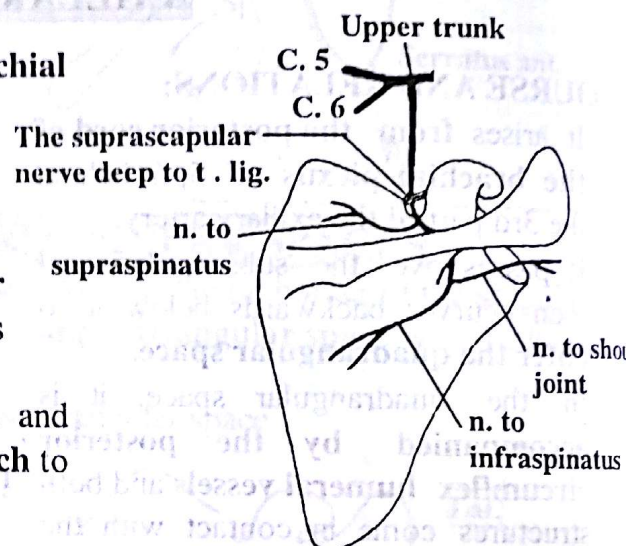


- The axillary nerve is exposed to injury in:
 1. Fracture of surgical neck of the humerus.
 2. Downwards dislocation of the head of the humerus.
 3. Compression by an axillary crutch.
- Injury of the leads to:
 1. Paralysis of the **deltoid and teres minor**: results in failure of abduction of the arm from 15° to 90° .
There is also **flattening of the rounded contour of the shoulder** due to loss of tone in the deltoid.
 2. Loss of cutaneous sensation: over the lower 1/2 of deltoid (the skin over the upper 1/2 of deltoid is supplied by the lateral supraclavicular nerve the cervical plexus).

SUPRASCAPULAR NERVE

COURSE AND RALATION:

- It arises from the **upper trunk of the brachial plexus** in the neck (C.5,6).
It runs downwards and laterally to reach the upper border of the scapula in company with the **suprascapular artery**.
- The nerve passes **deep to the suprascapular ligament**, while the suprascapular vessels pass superficial to the ligament.
- The nerve enters the **supraspinous fossa** and then passes through the **spinoglenoid notch** to reach the **infraspinous fossa**.



DISTRIBUTION:

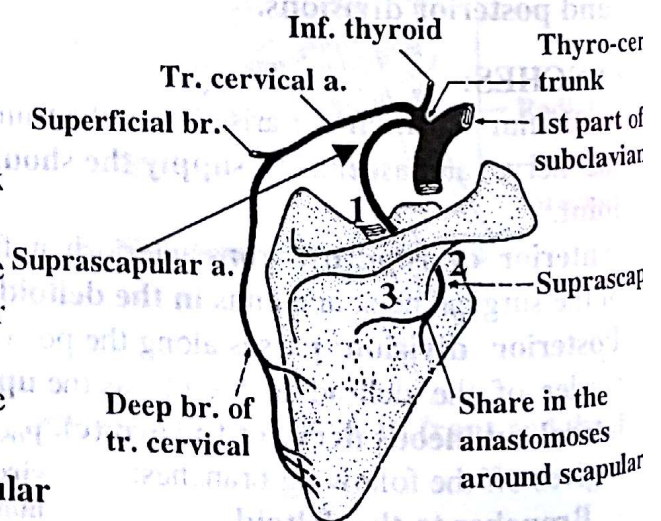
It supplies the following:

1. Supraspinatus muscle.
2. Infraspinatus muscle.
3. Shoulder and acromio-clavicular joints.

SUPRASCAPULAR ARTERY

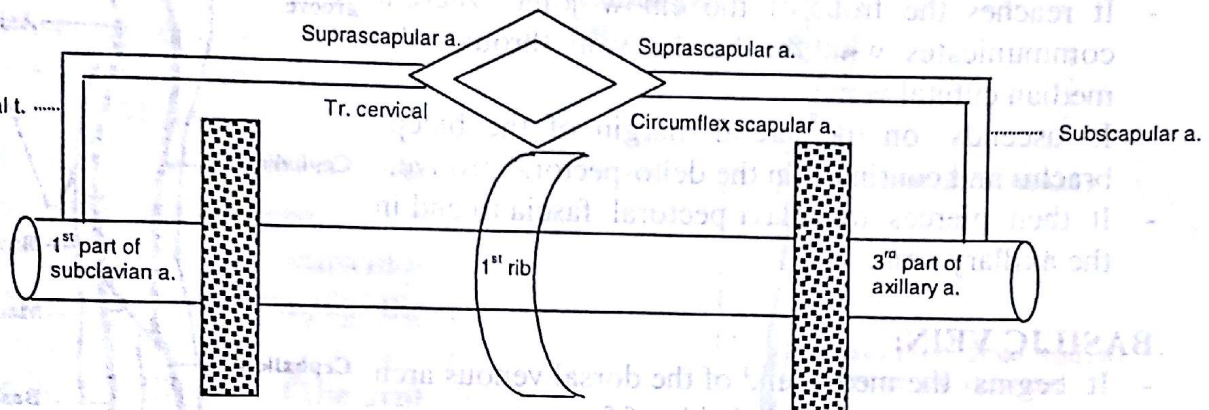
COURSE AND RELATIONS:

- It is a **branch of the thyro-cervical trunk of the 1st part of subclavian artery**.
It runs in the side of the neck behind the clavicle in company with the suprascapular nerve to reach the scapula.
(It may rarely arise from the 3rd part of the subclavian artery).
- It **passes superficial to the suprascapular ligament(1)** and enters the **supraspinous fossa**.
It continues through the **spinoglenoid notch(2)** to enter the **infraspinous fossa** (share in the anastomoses around scapula).



BRANCHES:

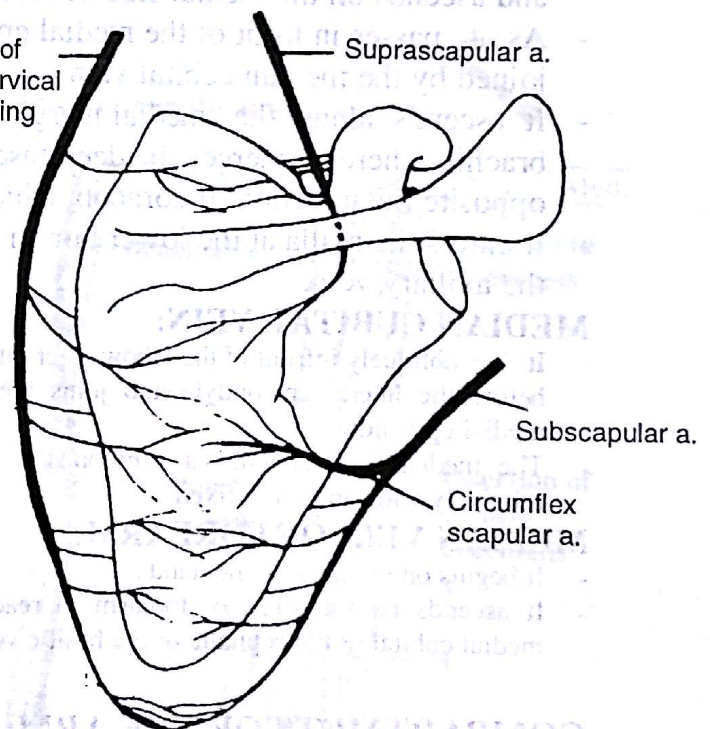
1. It gives branches to the anastomosis around the scapula.
 2. **Acromial branch:** anastomoses with the acromial branch of the thoraco-acromial a.
 3. **Nutrient branches:** to the clavicle and scapula.
 4. **Articular branches:** to the shoulder and acromio-clavicular joints.
- The transverse cervical artery is a branch of thyro-cervical trunk of 1st part of subclavian a.
 - It gives 2 branches:
 - i. Superficial branch passes with accessory nerve deep to trapezius.
 - ii. Deep branch passes with nerve to rhomboid on the medial border of scapula and sharing in the anastomoses around scapula.

ANASTOMOSIS AROUND THE SCAPULA:

It is an anastomosis between the 1st part of the subclavian artery and the 3rd part of axillary artery.

- From the 1st part of the subclavian artery arises the thyrocervical trunk which gives the **suprascapular** and the **deep branch of transverse cervical** arteries.
- From the 3rd part of axillary artery arises the **subscapular** and its branch **circumflex scapular** arteries.
- The site of the anastomosis is in the **infraspinatus** fossa of the scapula.
- This anastomosis is very important because it carries arterial blood to the upper limb, if the main arterial trunk is occluded between the first part of subclavian and third part of axillary arteries.

Deep branch of transverse cervical a. or descending scapular a.

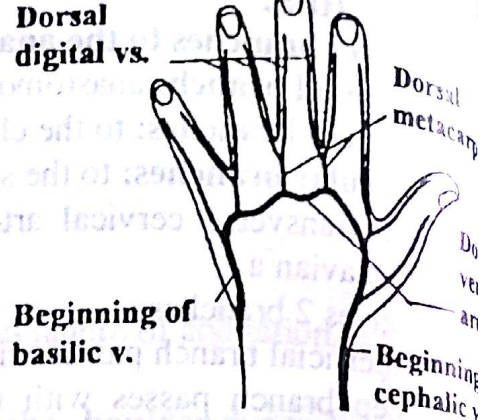
**Do not forget that:**

- The suprascapular nerve supplies the supraspinatus and infraspinatus muscles.
- The circumflex nerve supplies the deltoid and teres minor muscles.
- Teres major muscle is supplied by lower subscapular nerve.
- Subscapularis muscle is supplied by upper and lower subscapular nerves.

SUPERFICIAL VEINS OF UPPER LIMB

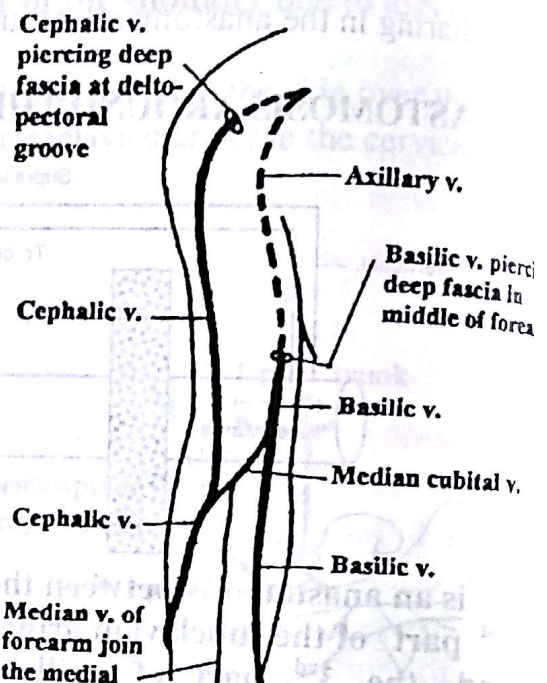
DORSAL VENOUS ARCH:

- It lies across the lower part of the dorsum of the hand.
- It gives origin to both the cephalic and basilic veins from the lateral and medial ends of the venous arch respectively.
- It receives the 3 dorsal metacarpal veins which receive in turn the dorsal digital veins from the fingers.



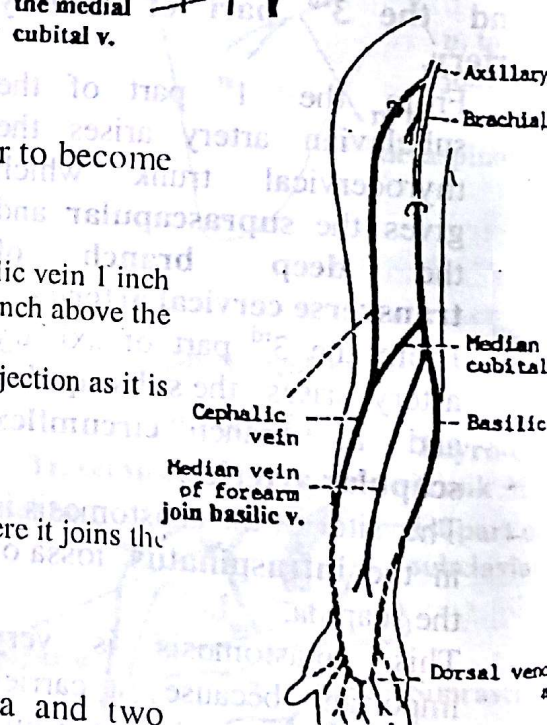
CEPHALIC VEIN:

- It begins from the lateral end of the dorsal venous arch and ascends on the lateral side of forearm.
- It reaches the front of the elbow joint where it communicates with the basilic vein through the median cubital vein.
- It ascends on the lateral margin of the biceps brachii and continues in the delto-pectoral groove.
- It then pierces the clavi-pectoral fascia to end in the axillary vein.



BASILIC VEIN:

- It begins the medial end of the dorsal venous arch and ascends on the medial side of forearm.
- As it passes in front of the medial epicondyle it is joined by the median cubital vein.
- It ascends along the medial margin of the biceps brachii where it pierces the deep fascia of the arm opposite the insertion of coracobrachialis.
- It enters the axilla at the lower border of teres major to become the axillary vein.



MEDIAN CUBITAL VEIN:

- It lies obliquely in front of the elbow where it joins the cephalic vein 1 inch below the lateral epicondyle and joins the basilic vein 1 inch above the medial epicondyle.
- The median cubital vein is a common site for intravenous injection as it is relatively wide and more fixed.

MEDIAN VEIN OF FOREARM:

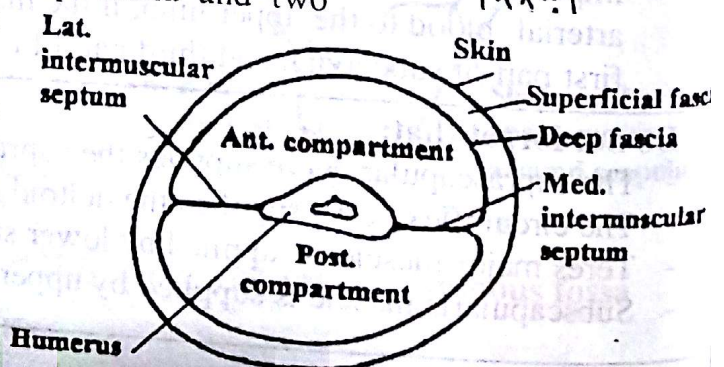
- It begins on the front of the hand.
- It ascends on the front of forearm to reach the elbow where it joins the median cubital or the cephalic or the basilic veins.

ARM

COMPARTMENTS OF THE ARM:

The arm is divided by the humerus deep fascia and two intermuscular septa (medial and lateral) into two compartments:

1. **Anterior compartment** (front of the arm).
2. **Posterior compartment** (back of the arm).



FRONT OF THE ARM

The front of the arm (anterior compartment of the arm) contains the following muscles:

1. Coraco-brachialis.
2. Biceps brachii.
3. Brachialis.

The anterior compartment contains also:

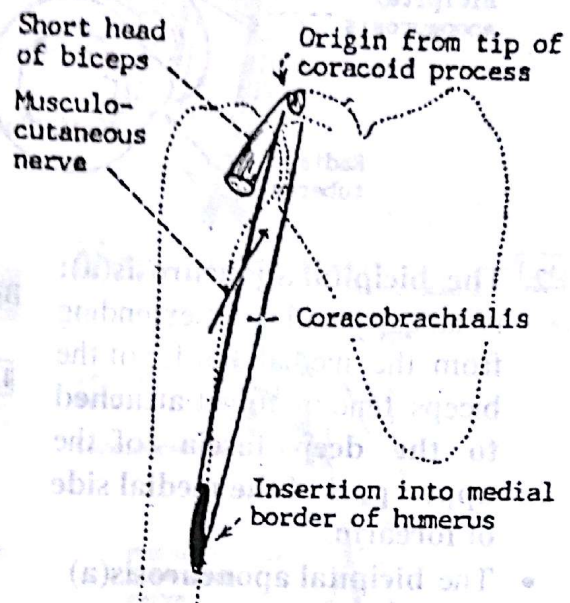
- Brachial artery, musculo-cutaneous nerve + parts of ulnar and median nerves.

MUSCLES OF THE FRONT OF ARM

CORACOBRACHIALIS

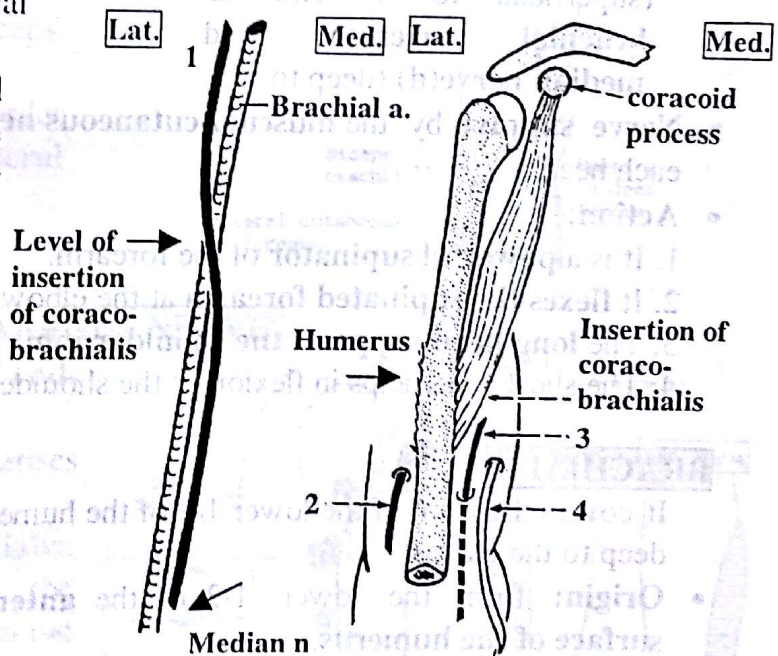
It lies in the upper part of the medial side of the arm.

- **Origin:** arises by a common tendon with the short head of biceps from the tip of the coracoid process.
- **Insertion:** into the middle of the medial border of the humerus.
- **Nerve supply:** by the musculo-cutaneous nerve which supplies the muscle before piercing it.
- **Action:** it helps in flexion of the arm at the shoulder joint.



Important landmarks occur at the level of insertion of coracobrachialis:

- **Median nerve(1):** crosses the brachial artery from lateral to medial.
- **Radial nerve(2):** pierces the lateral intermuscular septum after leaving the spiral groove to enter the anterior compartment.
- **Ulnar nerve(3):** pierces the medial intermuscular septum to enter the posterior compartment.
- **Basilic vein(4):** pierces the deep fascia to ascend medial to the brachial artery.
- **A nutrient artery:** enters the nutrient foramen in the humerus.



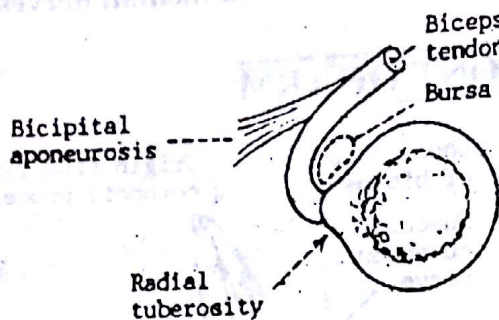
BICEPS BRACHII

It lies in front of the brachialis.

- **Origin:** by 2 heads (short and long)
 1. **Short head:** arises in common with the coracobrachialis from the tip of the coracoid process.
 2. **Long head:** arises from the supraglenoid tubercle. This tendon is inside the capsule of the shoulder joint. As it leaves the joint the tendon runs in the intertubercular (bicipital) groove of the humerus.

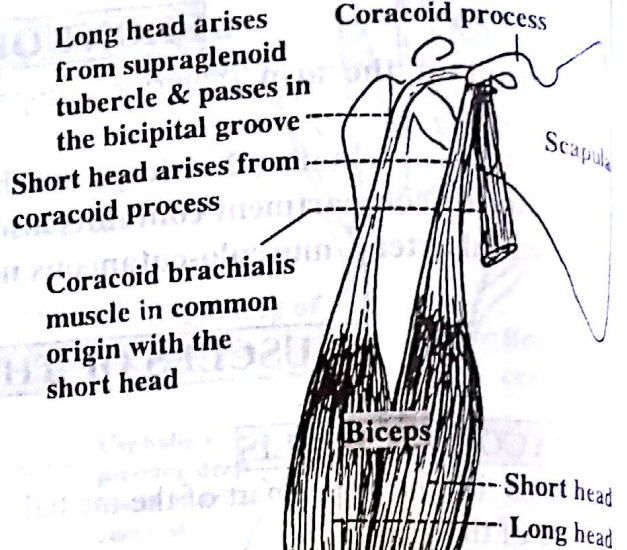
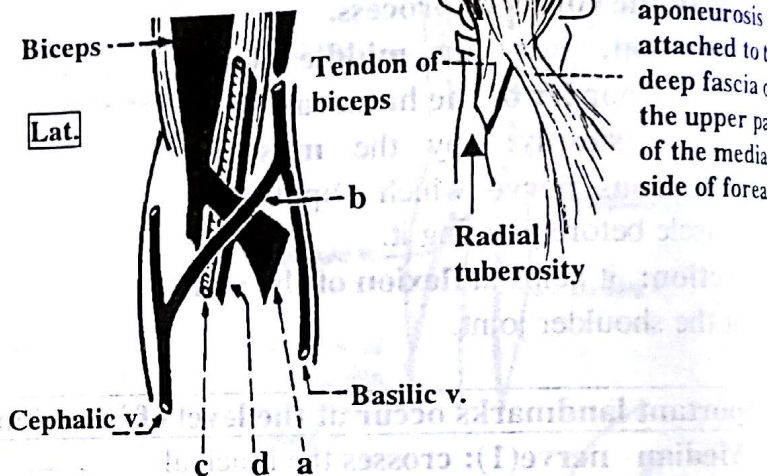


- **Insertion:** (by tendon and aponeurosis):
 1. **The tendon:** is inserted into the rough posterior part of the radial tuberosity, and is separated from the anterior smooth part of the tuberosity by a **synovial bursa**.



2. **The bicipital aponeurosis(a):** is an expanded sheet extending from the medial border of the biceps tendon to get attached to the deep fascia of the upper part of the medial side of forearm.

- The bicipital aponeurosis(a) intervenes between the median cubital vein(b) (superficial to it) and the brachial artery(c) and median nerve(d) (deep to it).



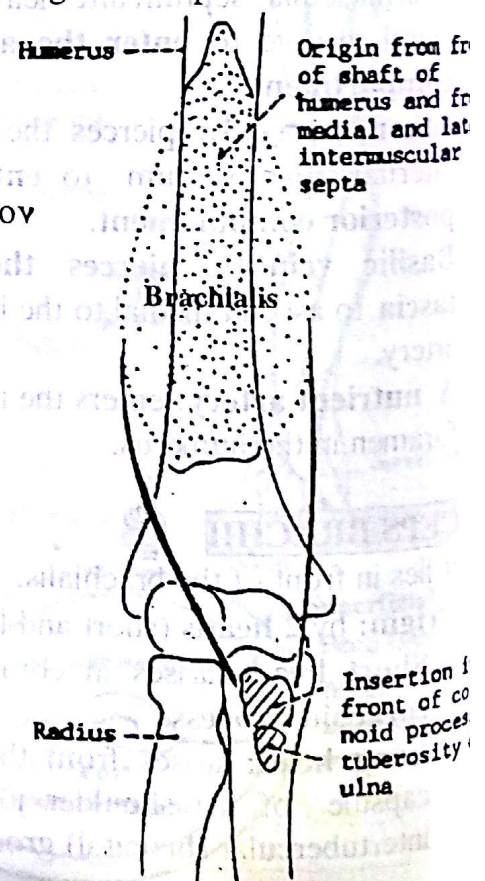
- **Nerve supply:** by the **musculo-cutaneous nerve** which gives a separate branch to each head.
- **Action:**
 1. It is a **powerful supinator** of the forearm.
 2. It **flexes the supinated forearm** at the elbow joint.
 3. The **long head supports the shoulder joint** from above.
 4. The **short head helps in flexion** of the shoulder joint.

BRACHIALIS



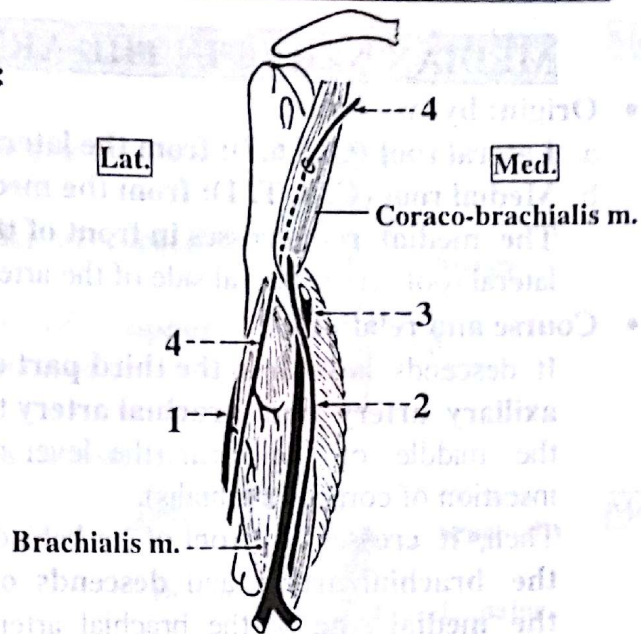
It covers the front of the lower 1/2 of the humerus deep to the biceps.

- **Origin:** from the lower 1/2 of the **anterior surface of the humerus**.
- **Insertion:** into the **tuberosity of the ulna** on the front of the coronoid process of the ulna.
- **Nerve supply:** by 2 nerves:
 1. **Musculo-cutaneous nerve.**
 2. **Radial nerve** (supplies its lateral part).
- **Action:** it is the **main flexor of the elbow** (with the forearm either supinated or pronated).



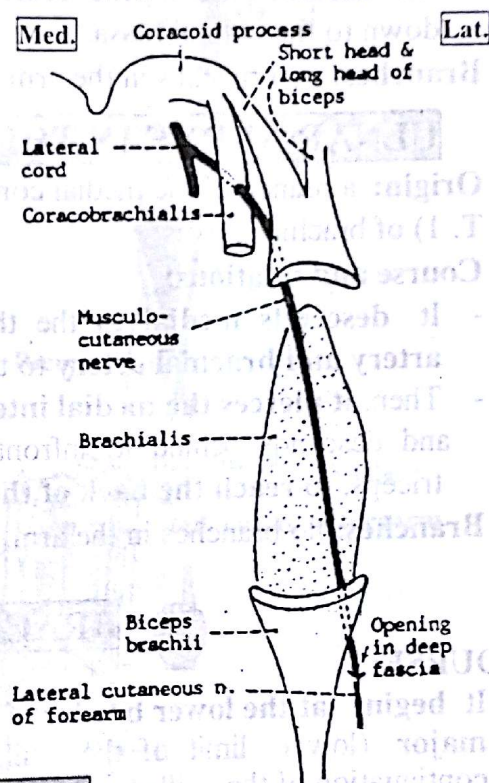
• Some important relations of brachialis:

- **Radial nerve(1)** accompanied with profunda brachii artery: on its lateral side of the muscle.
- **Median nerve(2) and brachial artery(3):** on the anterior surface of the muscle.
(The median nerve crosses the brachial artery from lateral to medial at the insertion of coraco-brachialis).
- **Musculo-cutaneous nerve(4):** on the anterior surface of the muscle between it and the biceps.



MUSCULO-CUTANEOUS NERVE

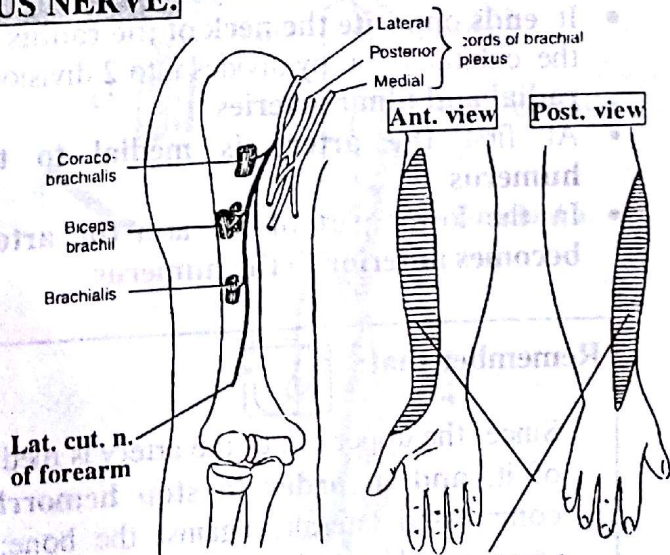
- **Origin:** The musculo-cutaneous nerve (C. 5, 6, 7) arises from the **lateral cord** of brachial plexus.
- **Course and relations:**
 - It pierces the **coracobrachialis muscle**. It then, passes downwards and laterally between the biceps and brachialis to appear on the lateral side of the tendon of the biceps, where it pierces the deep fascia.
 - It continues along the lateral border of the forearm as the **lateral cutaneous nerve of forearm**.



BRANCHES OF MUSCULO-CUTANEOUS NERVE:

It gives branches to 3 muscles and ends as a cutaneous nerve.

1. **A branch to coracobrachialis:** arises before the nerve pierces the muscle.
2. **Branches to biceps and brachialis:** arise after the nerve pierces the coracobrachialis in its course between the biceps and brachialis.
3. **Lateral cutaneous nerve of forearm:** supplies the skin over the anterior and posterior aspects of the lateral side of the forearm.



The areas of skin which is supplied by lat. cut. n. of forearm

MEDIAN NERVE IN THE ARM

- **Origin:** by two roots:

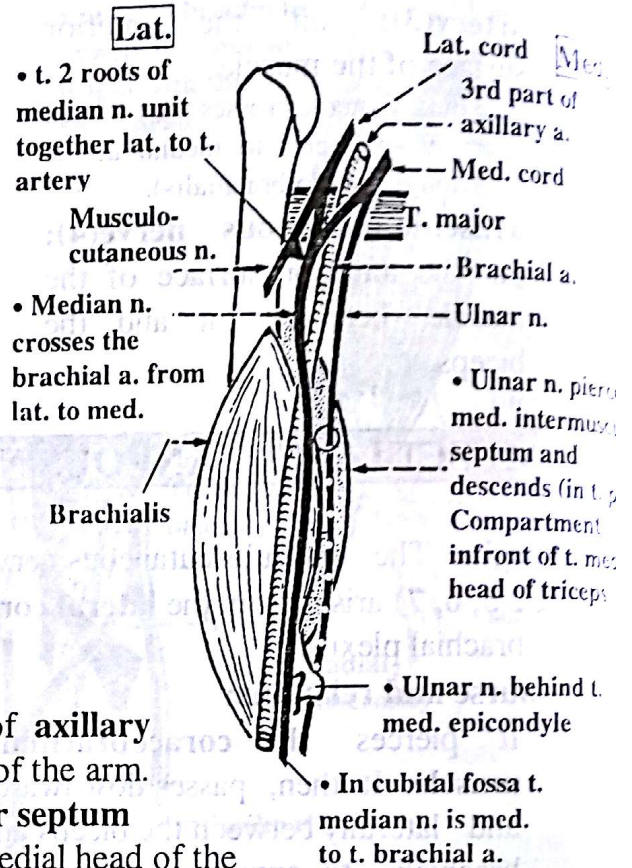
- a. **Lateral root (C. 5,6,7):** from the lateral cord of brachial plexus.
- b. **Medial root (C. 8, T. 1):** from the medial cord of brachial plexus.

The medial root crosses in front of the third part of the axillary and joins the lateral root on the lateral side of the artery.

- **Course and relations:**

- It descends **lateral** to the third part of axillary artery and brachial artery to the middle of the arm (the level of insertion of coraco-brachialis).
- Then, it crosses in front of (or behind) the brachial artery and descends on the **medial** side of the brachial artery down to the cubital fossa.

- **Branches:** no branches in the arm.



ULNAR NERVE IN THE ARM

- **Origin:** a branch of the medial cord (C. 7,8, T. 1) of brachial plexus.

- **Course and relations:**

- It descends **medial** to the third part of axillary artery and brachial artery to the middle of the arm.
- Then, it pierces the medial intermuscular septum and descends behind it, in front of the medial head of the triceps, to reach the back of the medial epicondyle.

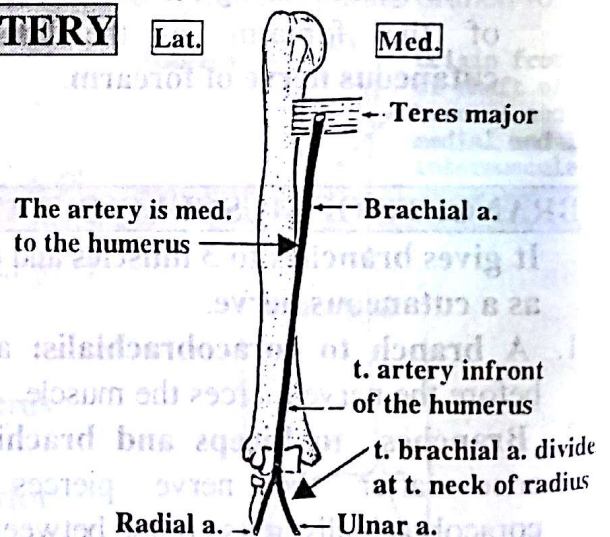
- **Branches:** no branches in the arm.



BRACHIAL ARTERY

COURSE:

- It **begins** at the lower border of the **teres major** (lower limit of the axilla) as the continuation of the axillary artery.
- It **ends opposite the neck of the radius** (in the cubital fossa) by divides into 2 divisions: **radial and ulnar arteries**.
- At first the artery is **medial to the humerus**.
- In the lower part of the arm the artery becomes **anterior to the humerus**.



Remember that:

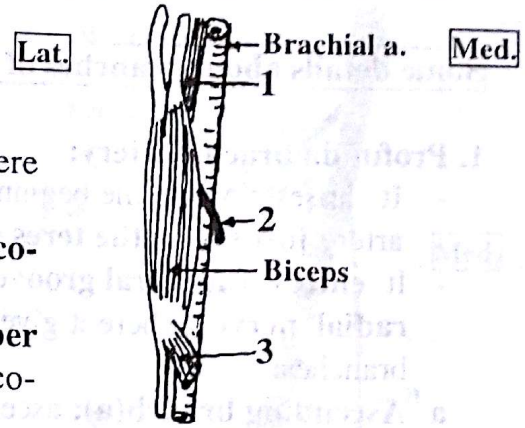


Since the upper 1/2 of the artery is medial to the humerus and its lower 1/2 is in front of it, **and in order to stop hemorrhage**, the upper part of the artery should be compressed laterally against the bone; but the lower part of the artery should be compressed backwards against the bone.

RELATIONS:

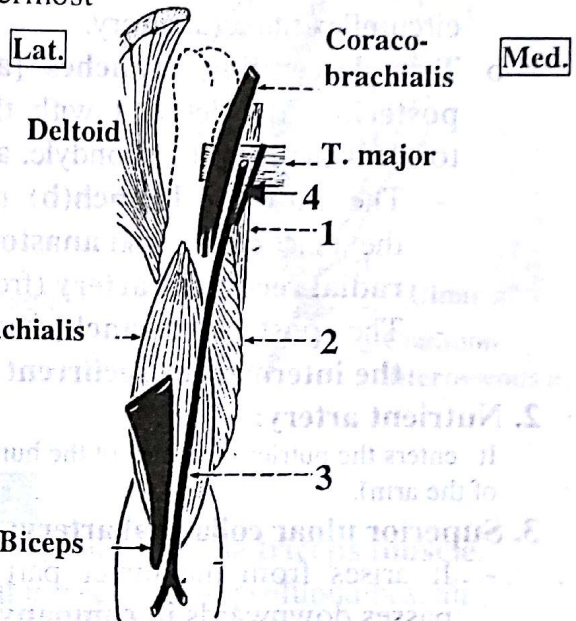
• Anteriorly:

1. It is **superficial throughout its whole extent** where it is only covered by skin and fascia.
It is overlapped by the medial border of **coracobrachialis(1)**.
2. The **median nerve(2)** crosses in front of its **upper** part from lateral to medial (at the insertion of coracobrachialis).
3. The **bicipital aponeurosis(3)** covers its lowermost part (at the elbow).



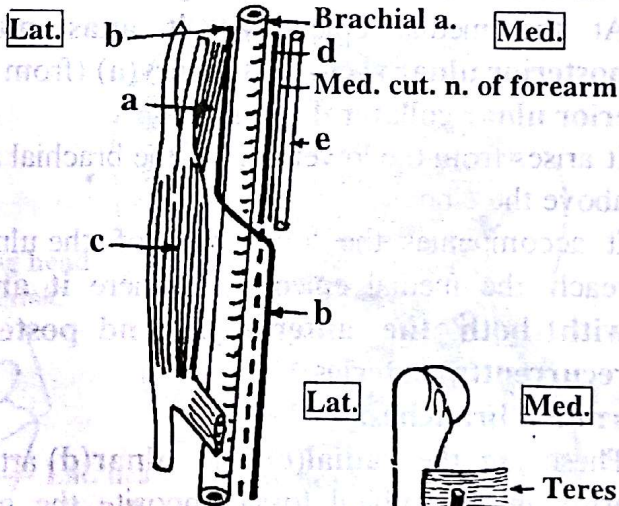
• Posteriorly:

- 3 muscles from above downwards.
 - Long head of triceps(1).
 - Medial head of triceps(2).
 - Brachialis(3) (where the artery comes in front of the arm).
- The **radial nerve(4)** lies behind its uppermost part between the artery and the long head of triceps.



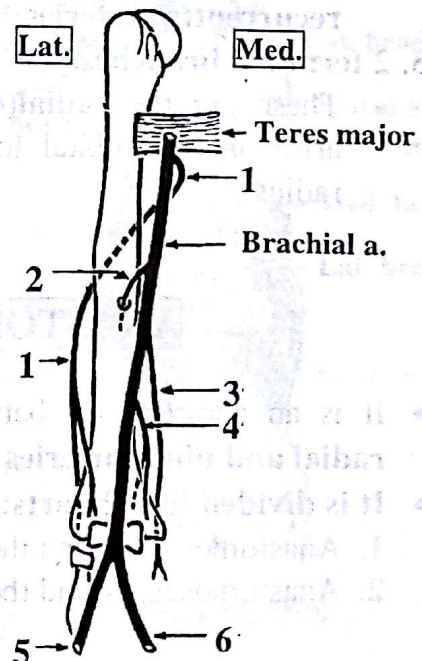
• Laterally:

- **Coracobrachialis(a)**: lateral to its uppermost part.
- **Median nerve(b)**: lateral to its upper part.
- **Tendon of biceps(c)**: lateral to its lowermost part.



• Medially:

- **Ulnar nerve(d)**: medial to its upper part.
- **Basilic vein(e)**: medial to its upper part.
- **Median nerve(b)**: medial to its lower part.



BRANCHES OF BRACHIAL ARTERY:

These are:

1. Profunda brachii.
2. Nutrient artery.
3. Superior ulnar collateral artery.
4. Inferior ulnar collateral artery
+ 2 terminal branches:
5. Radial artery.
6. Ulnar artery.

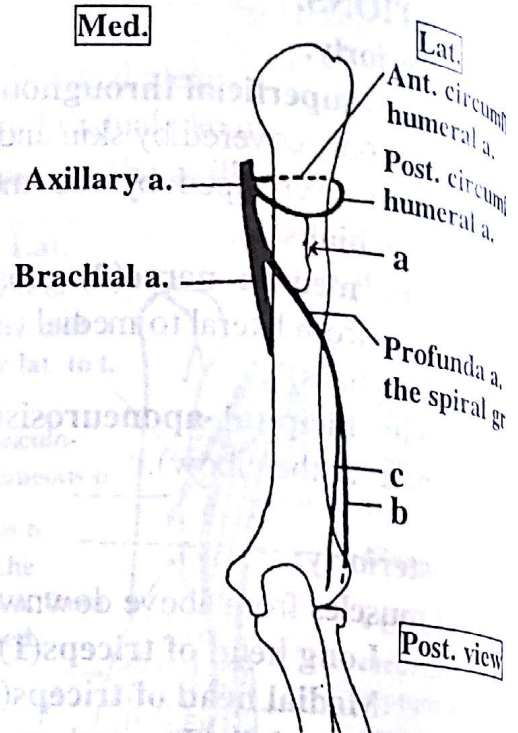


Some details about branches of axillary artery

1. Profunda brachii artery:

- It arises close to the beginning of the brachial artery just below the **teres major**.
- It enters the **spiral groove** together with the **radial nerve** where it gives off the following branches:

- Ascending branch(a)**: ascends on the back of the humerus to anastomose with the posterior circumflex humeral artery.
- Two descending branches [anterior(b) and posterior(c)]**: descend with the radial nerve towards the lateral epicondyle, as follows:
 - The **anterior branch(b)** runs **in front** of the epicondyle and **anastomoses with the radial recurrent artery** (from the radial).
 - The **posterior branch(c)** runs **behind** the epicondyle and **anastomoses with the interosseous recurrent artery** (from the posterior interosseous artery).



2. Nutrient artery:

It enters the nutrient foramen of the humerus at the insertion of the coracobrachialis (at the middle of the arm).

3. Superior ulnar collateral artery:

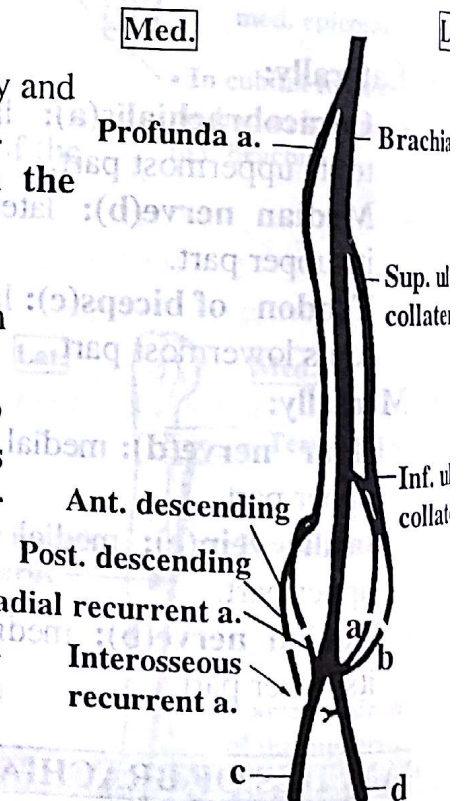
- It arises from the upper part of the brachial artery and passes downwards **in company with the ulnar nerve**.
- At the medial epicondyle it **anastomoses with the posterior ulnar recurrent artery(a)** (from the ulnar).

4. Inferior ulnar collateral artery:

- It arises from the lower part of the brachial artery 5 cm above the elbow.
- It accompanies the lower part of the ulnar nerve to reach the medial epicondyle where it **anastomoses with both the anterior(b) and posterior ulnar recurrent(a) arteries**.

5. 2 terminal branches:

- These are the **radial(c)** and **ulnar(d)** arteries which arise in the cubital fossa opposite the neck of the radius.



ANASTOMOSIS AROUND THE ELBOW

- It is an anastomosis between the **brachial artery** (above) and **upper parts of the radial and ulnar arteries** (below).
- It is divided into 2 parts:
 1. Anastomoses around the medial epicondyle and
 2. Anastomoses around the lateral epicondyle.



1. Anastomoses around medial epicondyle:

• In front:

- Anterior branch of the inferior ulnar collateral(a) (brachial).
- Anterior ulnar recurrent(b) (ulnar).

• Behind:

- Posterior branch of the inferior ulnar collateral (brachial).
- Superior ulnar collateral(c) (brachial).
- Posterior ulnar recurrent(d) (ulnar).

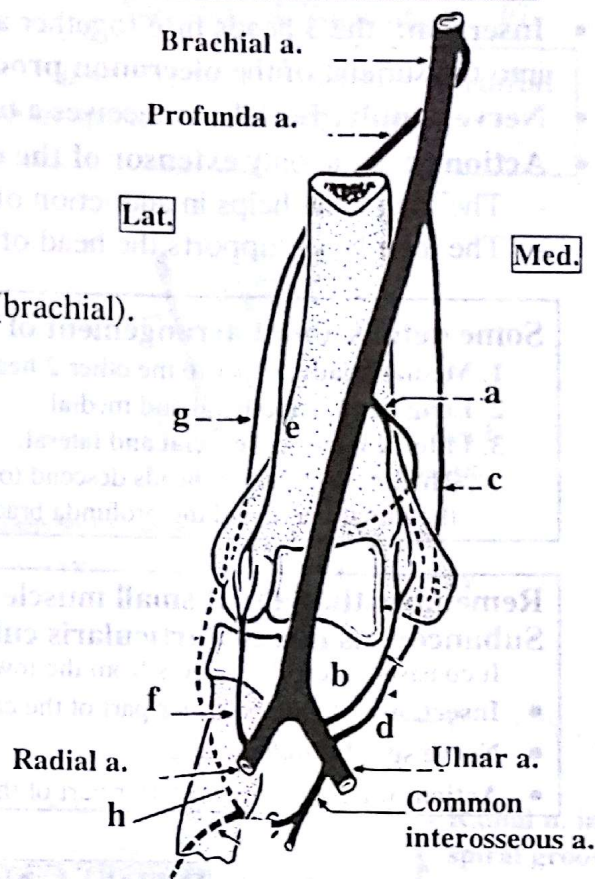
2. Anastomoses around lateral epicondyle:

• In front:

- Anterior descending branch of profunda brachii(e) (brachial).
- Radial recurrent(f) (radial).

• Behind:

- Posterior descending branch of profunda brachii(g) (brachial).
- Interosseous recurrent(h) (posterior interosseous from ulnar).

**BACK OF THE ARM**

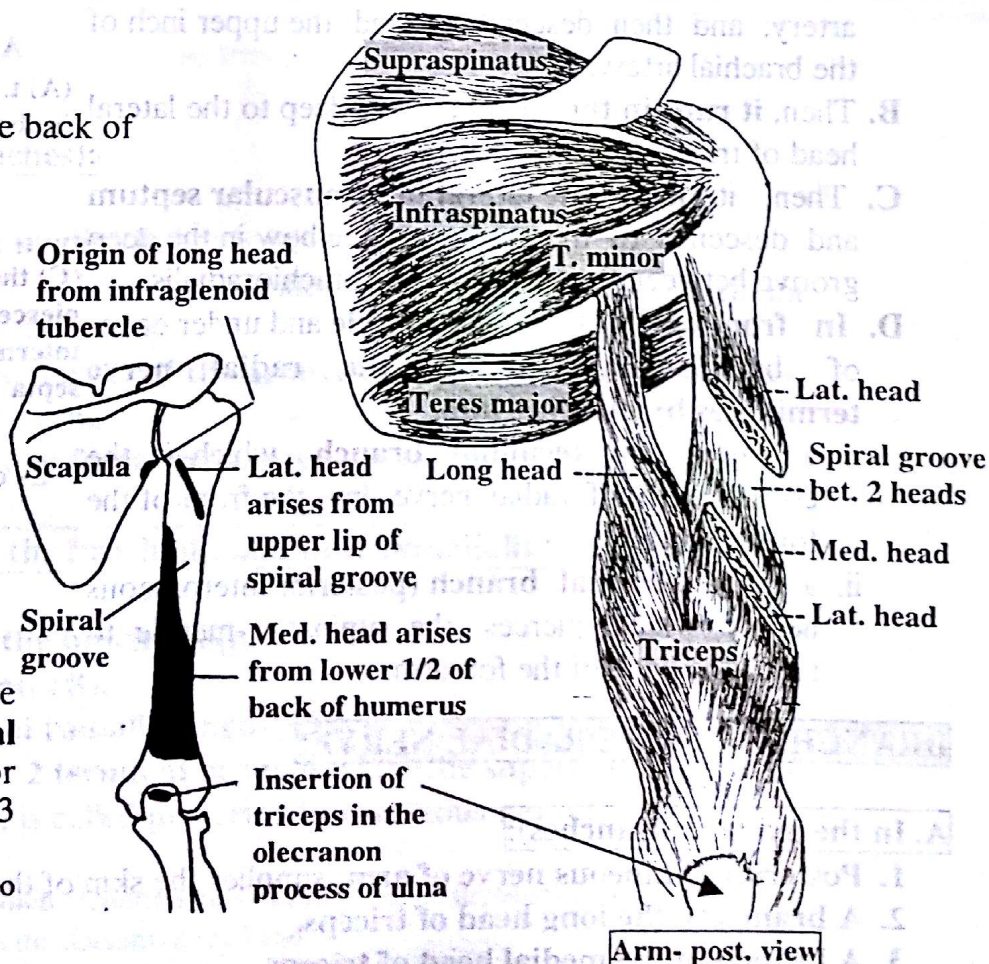
- The back of the arm (posterior compartment of the arm) contains the triceps muscle.
- The posterior compartment contains also the radial nerve and the profunda brachii artery (described before).

TRICEPS

It is the only muscle on the back of the humerus.

• Origin: by 3 heads:

1. Long head: from the infraglenoid tubercle.
2. Medial head: from the lower 1/2 of the back of the humerus and both intermuscular septa below the spiral groove.
3. Lateral head: from the upper lip of the spiral groove on the posterior surface of the upper 1/3 of the humerus. It descends over the groove to form its roof.



Upper Limb

- **Insertion:** the 3 heads fuse together above the elbow and are inserted by one tendon into the summit of the **olecranon process of the ulna**.
- **Nerve supply:** Each head receives a branch from the **radial nerve**.
- **Action:** it is the only **extensor of the elbow joint**.
 - The long head helps in adduction of the arm.
 - The long head supports the head of humerus in the abducted shoulder.

Some details about arrangement of the 3 heads of the triceps:

1. **Medial head:** deeper to the other 2 heads.
2. **Long head:** superficial and medial.
3. **Lateral head:** superficial and lateral.

The long and lateral heads descend to join the medial head. Therefore the lateral head covers the radial nerve and the profunda brachii vessels in the spiral groove.

Remember that about small muscle in the back of the arm called: **Subanconeus muscle (articularis cubiti)**

It consists of few deep fibers from the lower part of the triceps.

- **Insertion:** into the posterior part of the capsule of the elbow joint.
- **Nerve supply:** radial nerve.
- **Action:** it pulls up the posterior part of the capsule of the elbow during extension of the elbow.

RADIAL NERVE IN THE ARM

- **Origin:** The radial nerve (C. 5,6,7,8 & T. 1) is the continuation of the posterior cord of brachial plexus.
- **Course and relations:**

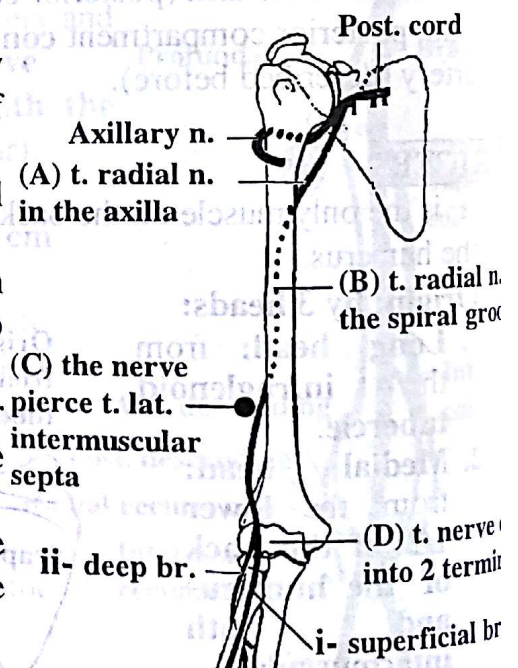
A. In the axilla it lies behind the third part of axillary artery; and then descends behind the upper inch of the brachial artery.

B. Then, it runs in the spiral groove deep to the lateral head of triceps.

C. Then, it pierces the lateral intermuscular septum and descends to the front of the elbow in the deep groove between the brachialis and brachioradialis.

D. In front of the lateral epicondyle and under cover of brachioradialis muscle, the radial nerve terminates by dividing into:

- i. a **superficial terminal branch** which is the continuation of radial nerve into the front of the forearm and
- ii. a **deep terminal branch** (posterior interosseous nerve) which pierces the supinator muscle to reach the back of the forearm.



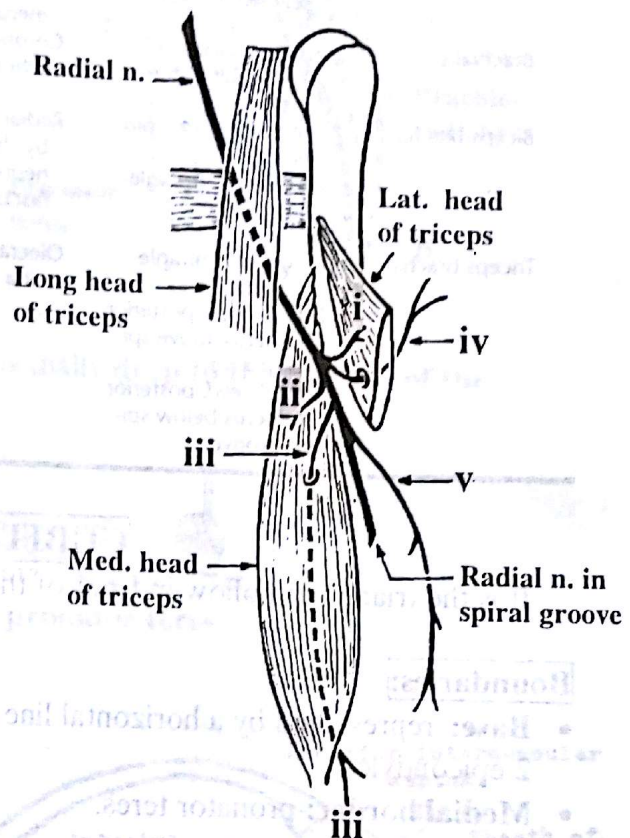
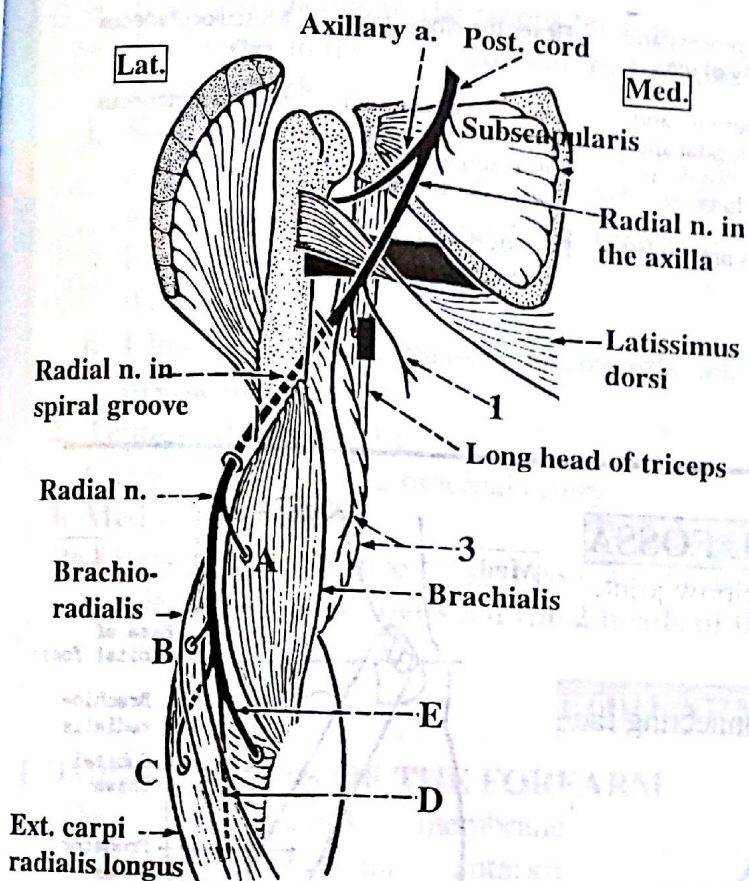
BRANCHES OF THE RADIAL NERVE:

A. In the axilla (3 branches):

1. **Posterior cutaneous nerve of arm:** supplies the skin of the back of the arm.
2. **A branch to the long head of triceps.**
3. **A branch to the medial head of triceps.**

Arm - ant. view - branches of radial nerve in the axilla & groove between the brachialis and brachioradialis

Arm - post. view - branches of radial nerve in spiral groove of humerus



B. In the spiral groove (5 branches):

Branches to the lateral(i) & medial(ii) heads of the triceps.

- Nerve to anconeus(iii): a long and slender nerve which runs through the substance of the medial head of triceps.
- Lower lateral cutaneous nerve of the arm(iv): supplies the skin on the lower part of the lateral side of the arm.
- Posterior cutaneous nerve of forearm(v): descends to supply the back of forearm.

C. In the deep groove between the brachialis and brachioradialis (5 branches):

- Nerve to lateral fibers of the brachialis(A).
- Nerve to the brachioradialis(B).
- Nerve to the extensor carpi radialis longus(C).
- This is in addition to its 2 terminal branches: [(D)the superficial branch & (E)the deep branch which is called posterior interosseous nerve]

- The superficial terminal branch (continuation of radial nerve) descends as a small nerve in the front of the forearm to reach the dorsum of the hand.
- The deep terminal branch (the posterior interosseous nerve) passes through the supinator muscle to reach the back of the forearm.

Summary for the muscles of the arm

NAME	ORIGIN	INSERTION	ACTION	INNERVATION
Coracobrachialis	Coracoid process of scapula	Middle portion of the medial surface of humerus	Flexes and adducts arm	Musculocutaneous nerve
Brachialis	Anterior surface of lower half of humerus	Coronoid process and tuberosity of ulna	Flexes the elbow joint	Musculocutaneous nerve
Biceps brachii	Short head: coracoid process Long head: supraglenoid tubercle	Radial tuberosity and by the bicipital aponeurosis into deep fascia of forearm	Flexes the elbow joint, supinates the forearm, and weakly flexes the shoulder joint	Musculocutaneous nerve
Triceps brachii	Long head: infraglenoid tubercle Lateral head: posterior humerus above spiral groove Medial head: posterior humerus below spiral groove	Olecranon process of ulna	Extends the elbow joint	Radial nerve

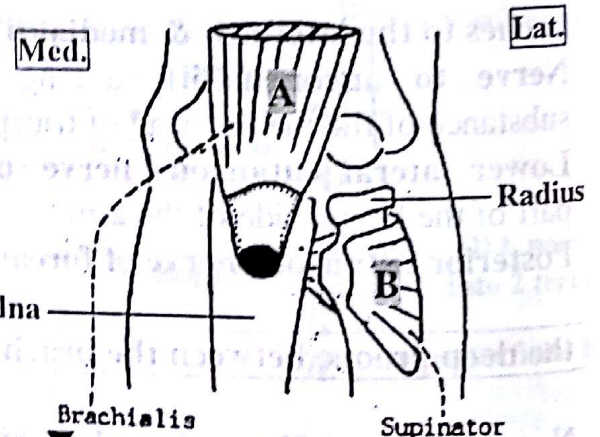
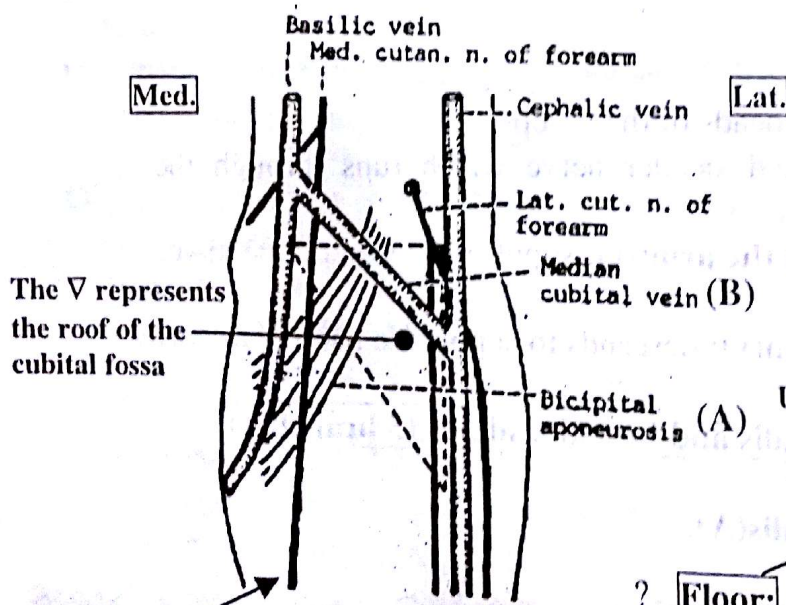
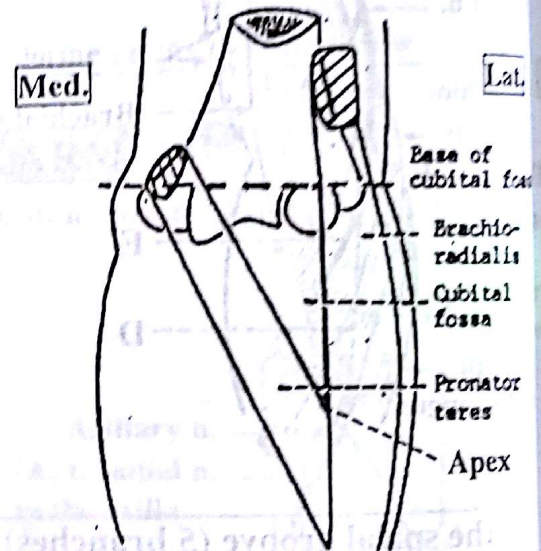


CUBITAL FOSSA

It is the triangular hollow in front of the elbow joint.

Boundaries:

- **Base:** represented by a horizontal line connecting the 2 epicondyles.
- **Medial border:** pronator teres.
- **Lateral border:** brachioradialis.
- ? **Apex:** at the meeting of the lateral and medial borders.



- **Roof:** is formed by the following:
 - Skin and fascia.
 - Bicipital aponeurosis(A).
 - Median cubital vein(B).

- ? **Floor:** is formed by the insertion of 2 muscles:
- Brachialis(A): covers the front of the elbow joint
 - Supinator(B): covers the upper part of the radius

Contents of cubital fossa:

These are the brachial artery and its 2 terminal divisions, tendon of biceps and median nerve.

1. Brachial artery(A):

- It lies just medial to the biceps tendon.
- It divides in the fossa into the radial and ulnar arteries.

i. **Radial artery(B):** passes downwards and laterally on the supinator where it accompanies the superficial terminal branch of radial nerve under cover of the brachioradialis.

ii. **Ulnar artery(C):** passes downwards and medially deep to the 2 heads of the pronator teres.

2. Tendon of biceps(D):

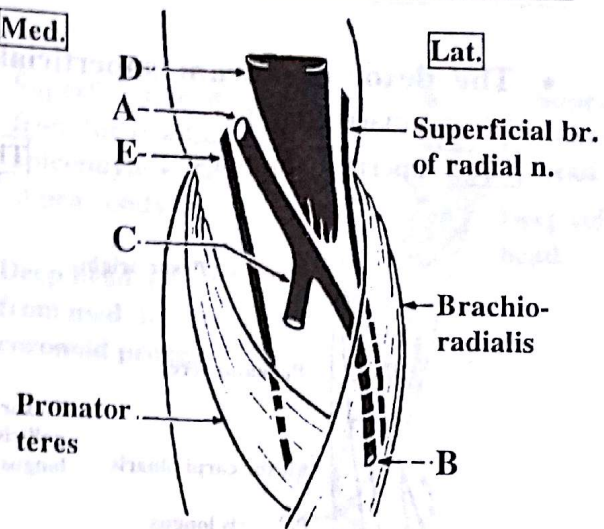
Lies just lateral to the brachial artery.

3. Median nerve(E):

- Passes in the midline of the fossa, just medial to the brachial artery.
- It leaves the fossa between the 2 heads of the pronator teres.

Med.

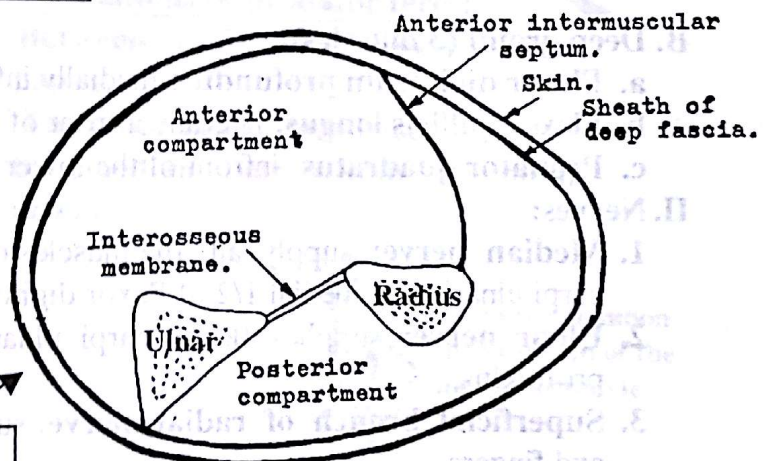
Lat.

**FOREARM****COMPARTMENTS OF THE FOREARM**

- The interosseous membrane together with an anterior intermuscular septum divide the forearm into 2 compartments:

1. Anterior or flexor compartment.**2. Posterior or flexor compartment.**

- Each compartment has its muscles, nerves and blood vessels.



Transverse section in the forearm to show the anterior and posterior compartment

THE ANTERIOR COMPARTMENT OF THE FOREARM**CONTENTS:****I. Muscles:**

The muscles of the front of forearm are called collectively the flexor group, and are arranged into 2 layers: superficial and deep.

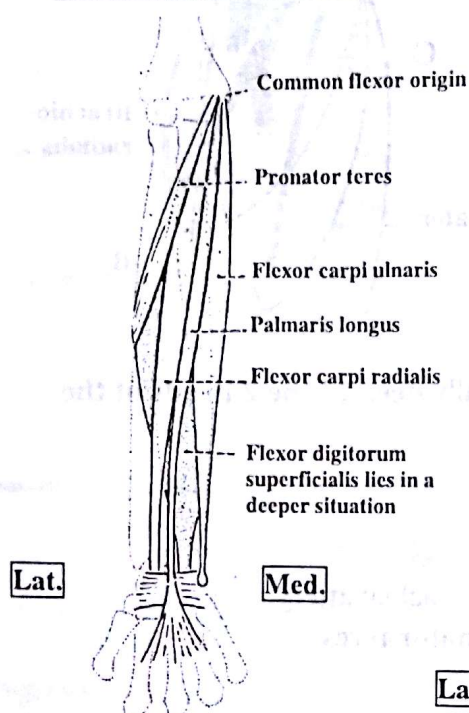
A. Muscles of superficial layer (5 muscles):

- The 5 muscles of the superficial layer are:
 - a. pronator teres,
 - b. flexor carpi radialis,
 - c. palmaris longus,
 - d. flexor digitorum superficialis,
 - e. flexor carpi ulnaris.

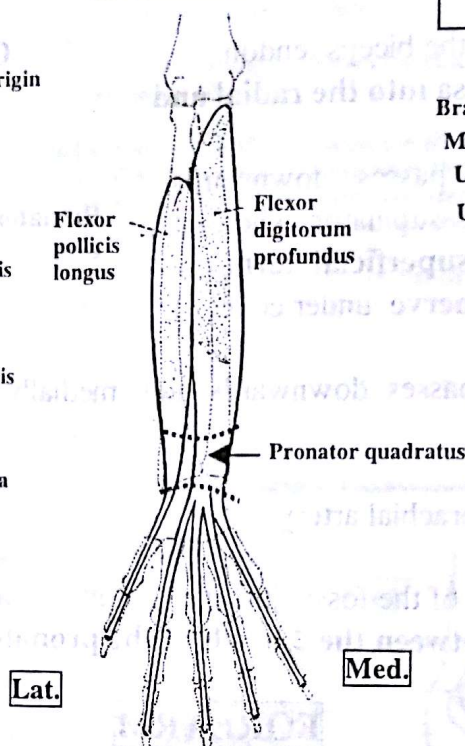
All these muscles arise by a common tendon from the front of the medial epicondyle.

- The **flexor digitorum superficialis** is situated deeper to the **flexor carpi radialis** and **palmaris longus**.

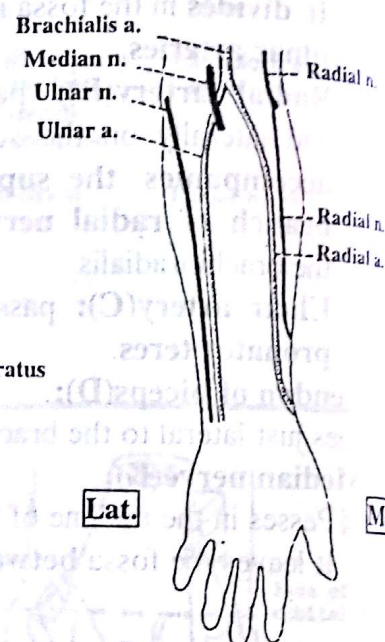
The 5 superficial muscles



The 3 deep muscles



The nerves and vessels of the ant. compartment



B. Deep group (3 muscles):

- Flexor digitorum profundus:** medially in front of the ulna.
- Flexor pollicis longus:** laterally in front of the radius.
- Pronator quadratus:** in front of the lower parts of radius and ulna.

II. Nerves:

- Median nerve:** supply all the muscles of the front of the forearm **except** flexor carpi ulnaris and medial 1/2 of flexor digitorum profundus.
- Ulnar nerve:** supplies flexor carpi ulnaris and medial 1/2 of flexor digitorum profundus.
- Superficial branch of radial nerve:** supplies a skin on the dorsum of the hand and fingers.

III. Vessels: 1. Ulnar artery and 2. Radial artery.

MUSCLES OF THE ANTERIOR COMPARTMENT OF THE FOREARM

- A. Superficial muscles:** 1. Pronator teres. 2. Flexor carpi radialis. 3. Palmaris longus. 4. Flexor digitorum superficialis. 5. Flexor carpi ulnaris.

PRONATOR TERES

It is the most lateral muscle of the group.

- Origin:** by 2 heads (superficial and deep)
 - Superficial (humeral) head:** is large and arises from the front of the medial epicondyle (common flexor origin) and from the medial supracondylar ridge just above the medial epicondyle.
 - Deep (ulnar) head:** is small and arises from the medial border of the coronoid process of the ulna.

- **Insertion:** into a rough area at the **middle of the lateral surface of the radius**.
- **Nerve supply:** median nerve (while in the cubital fossa).
- **Action:** **pronates the forearm** (i.e. rotates the radius upon the ulna so as to turn the palm of the hand downwards or backwards).

Insertion into t. middle of lat. surface of radius

Humerus

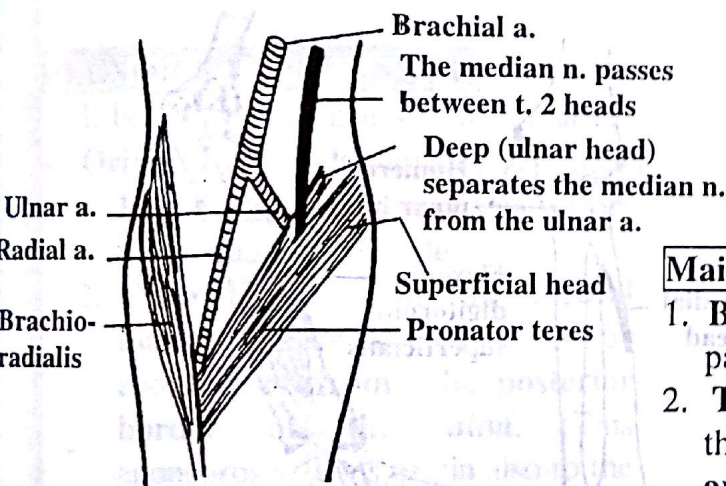
Superficial head, arises from the front of med. epicondyle + med. supra condylar ridge

Deep head arises from med. border of coronoid process

Insertion

Superficial (humeral) head

Deep (ulnar) head



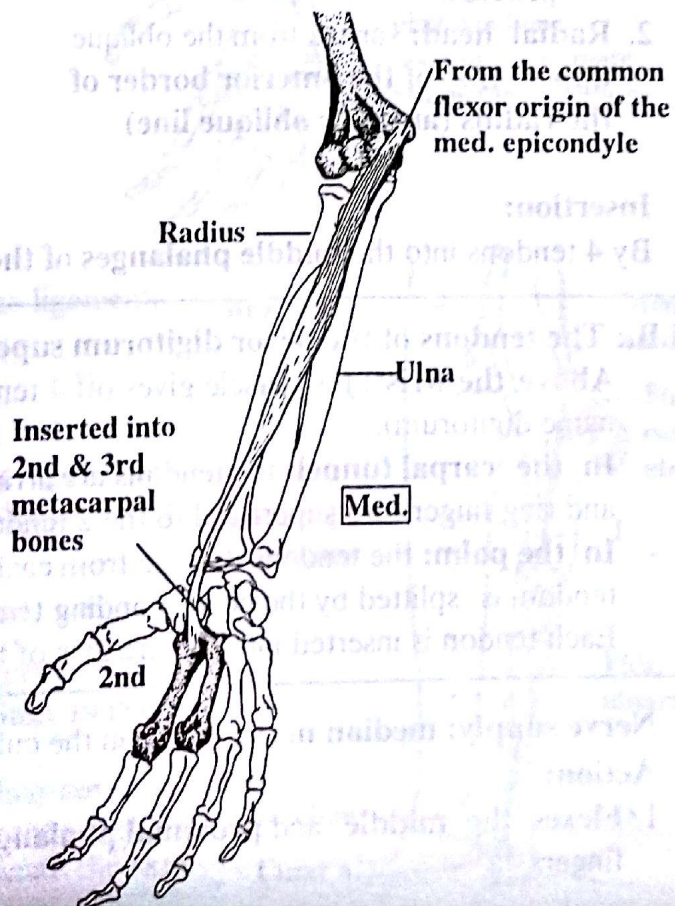
Main relations of pronator teres:

1. Between its 2 heads the median nerve passes.
2. The ulnar head (deep head) separates the median nerve from the ulnar artery.

FLEXOR CARPI RADIALIS

It lies just medial to the pronator teres.

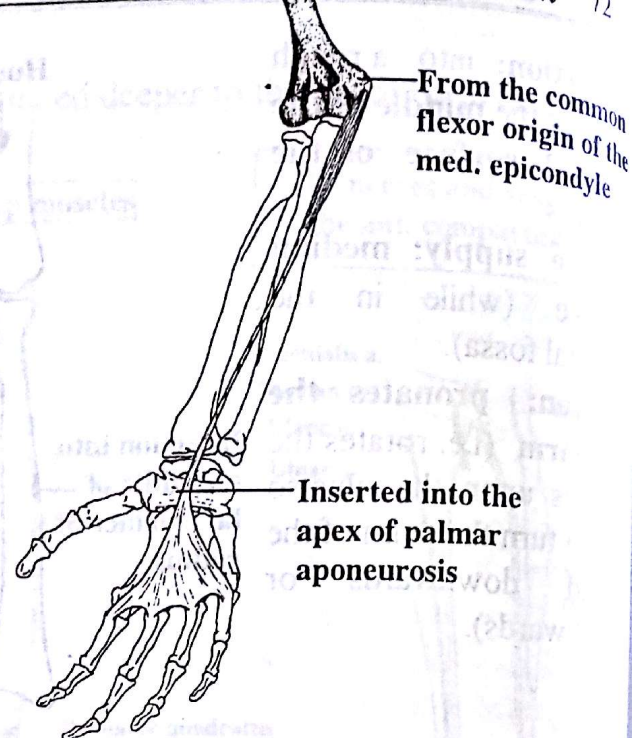
- **Origin:** from the **common flexor origin** which arises from the front of the medial epicondyle.
- **Insertion:** its tendon passes in a groove on the anterior surface of the trapezium to get **inserted into the palmar surface of the bases of the 2nd and 3rd metacarpal bones**.
- **Nerve supply:** median nerve (while in the cubital fossa).
- **Action:** **flexes and abducts the wrist**.



PALMARIS LONGUS

It lies medial to the flexor carpi radialis. It may be absent.

- **Origin:** from the **common flexor origin** (from the medial epicondyle).
- **Insertion:** into the **apex of the palmar aponeurosis**. The tendon crosses superficial to the flexor retinaculum.
- **Nerve supply:** median nerve (while in the cubital fossa).



FLEXOR DIGITORUM SUPERFICIALIS

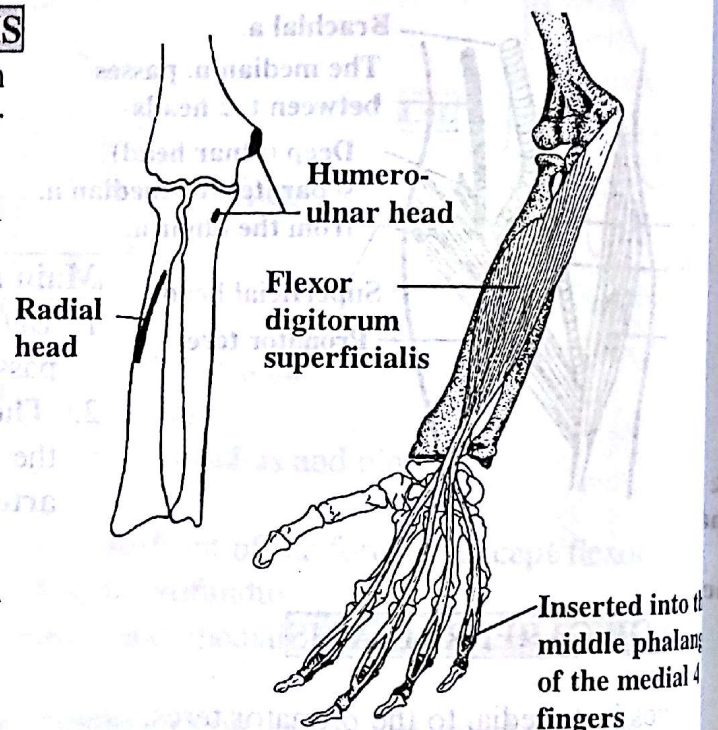
It lies superficial to the flexor digitorum profundus and deep to both the flexor carpi radialis and palmaris longus.

- **Origin:** by 2 heads (humero-ulnar and radial).

1. **Humero-ulnar head:** arises from 2 areas.

- Front of the medial epicondyle (common flexor origin).
- Medial side of the coronoid process.

2. **Radial head:** arises from the oblique upper 1/3 of the anterior border of the radius (anterior oblique line).



- **Insertion:**

By 4 tendons into the **middle phalanges of the medial 4 fingers**.

N.B.: The tendons of the flexor digitorum superficialis take the following course:

- **Above the wrist:** the muscle gives off 4 tendons for the medial 4 digits (hence the name digitorum).
- **In the carpal tunnel:** the tendons are arranged so as the 2 tendons of the middle and ring fingers are superficial to the 2 tendons of the index and little fingers.
- **In the palm:** the tendons diverge from each other to reach the fingers where each tendon is splitted by the corresponding tendon of the flexor digitorum profundus. Each tendon is inserted into the margins of the middle phalanx.

- **Nerve supply:** median nerve (while in the cubital fossa).

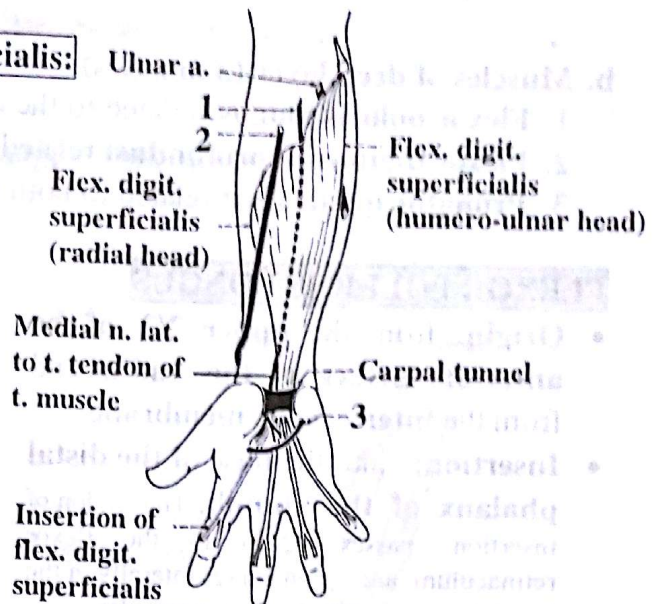
- **Action:**

1. **Flexes the middle and proximal phalanges** (not the distal ones) of the medial 4 fingers.

2. Assists in flexion of the wrist joint.

Main relations of the flexor digitorum superficialis:

1. The **median nerve**(1) in the forearm runs on the **under surface of the muscle**. However, in the carpal tunnel the nerve lies on the lateral side of the tendons of the muscle.
2. The **radial artery**(2) and superficial terminal branch of radial nerve run superficial to the origin of the radial head of the muscle.
3. The **superficial palmar arch**(3) and palmar aponeurosis are superficial to the tendons of the muscle in the hand.

**FLEXOR CARPI ULNARIS**

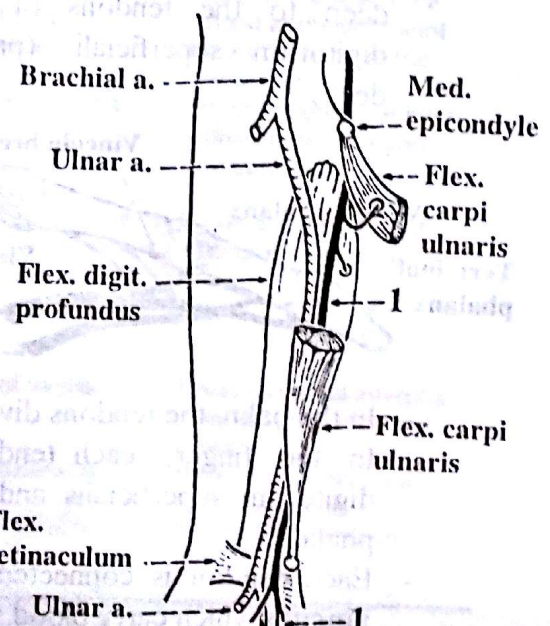
It lies along the ulnar side of forearm.

- **Origin:** by 2 heads (humeral and ulnar)
 1. **Humeral head:** (very small) from the **medial epicondyle**.
 2. **Ulnar head:** from the **medial margin of the olecranon** and by aponeurosis from the **posterior border of the ulna**. (This aponeurosis gives origin also to the extensor carpi ulnaris and flexor digitorum profundus).
- **Insertion:** into the **pisiform bone** from which the insertion extends to 2 bones through 2 ligaments as follows:
 1. **To the base of 5th metacarpal bone:** through the **piso-metacarpal ligament**.
 2. **To the hamate:** through the **piso-hamate ligament**.
- **Nerve supply:** ulnar nerve.
- **Action:**
 1. **Acting alone:** it flexes and **adducts** the wrist joint.
 2. **Acting with the flexor carpi radialis:** it produces only flexion of the wrist (with neither adduction nor abduction).

Main relations of the flexor carpi ulnaris:

It is related to the ulnar nerve and ulnar artery as follows:

1. **In the upper 2/3 of forearm:** the **ulnar nerve**(1) lies deep to the muscle.
2. **In the lower 1/3 of forearm:** the ulnar nerve and Flex. artery lie on the lateral side of the tendon of the **retinaculum** muscle, where they come superficial beneath the skin.



b. Muscles of deep layer (3 muscles)

1. Flexor pollicis longus: related to the radius.
2. Flexor digitorum profundus: related to the ulna.
3. Pronator quadratus: related to both radius and ulna.

FLEXOR POLLICIS LONGUS

- **Origin:** from the upper 2/3 of the anterior surface of the radius and from the interosseous membrane.
- **Insertion:** into the base of the distal phalanx of the thumb. The tendon of insertion passes deep to the flexor retinaculum and then curves laterally in the hand, just medial to the thenar muscles.
- **Nerve supply:** anterior interosseous branch of the median nerve.
- **Action:** flexion of all joints of the thumb.

Origin from ant.
surface of radius +
interosseous membrane

Insertion into the
base of the distal
phalanx of the thumb

FLEXOR DIGITORUM PROFUNDUS

- **Origin:** from 3 areas
 1. From the upper 2/3 of the anterior and medial surfaces of the ulna.
 2. From the aponeurosis attached to the posterior border of the ulna.
 3. From the interosseous membrane.

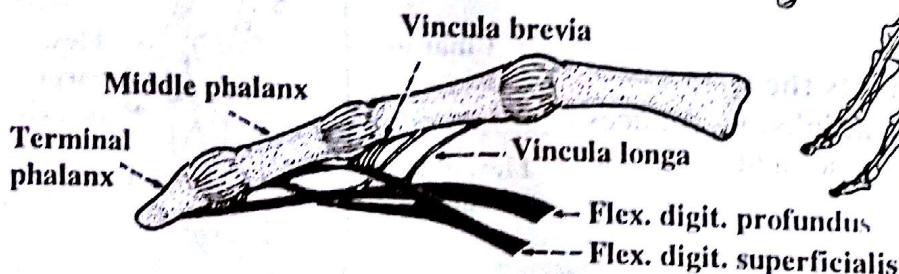
• **Insertion:**

By 4 tendons into the bases of the terminal phalanges of the medial 4 fingers. The tendons take the following course:

- They pass through the carpal tunnel deep to the tendons of the flexor digitorum superficialis (profundus = deep).

Origin from the ant.
med. surface of the
post. border of ulna
interosseous membrane

Insertion into the
terminal phalanx of
the medial n. fingers



- In the palm, the tendons diverge to reach the fingers.
- In the finger, each tendon pierces the corresponding tendon of the flexor digitorum superficialis and continues to get attached to the base of the terminal phalanx.
- Each tendon is connected to the phalanges by vascular fibrous bands called **vincula** which carry blood vessels to supply the tendon.

- **Nerve supply:**

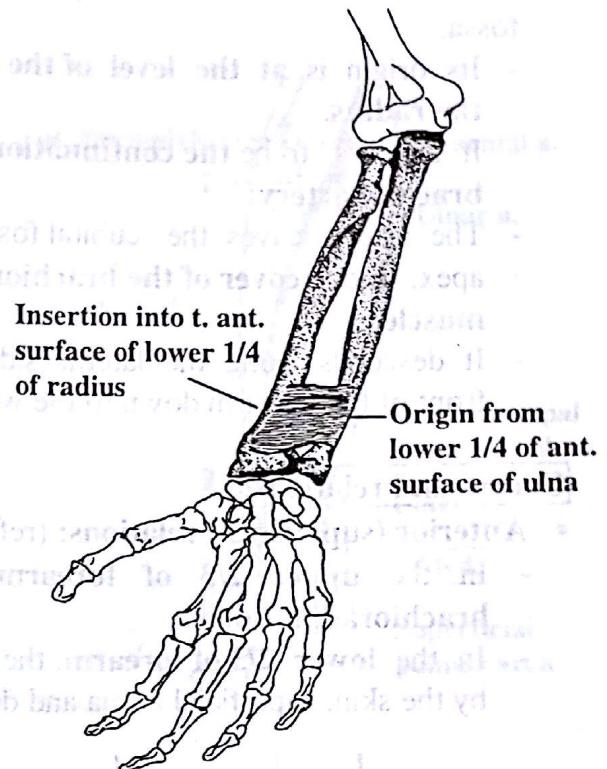
1. Anterior interosseous branch of the median nerve (to its lateral part).
2. Ulnar nerve (to its medial part).

- **Action:**

1. Flexes the proximal, middle and distal phalanges of the medial 4 fingers.
2. Helps in flexion of the wrist joint.

PRONATOR QUADRATUS

- **Origin:** from the lower 1/4 of the anterior surface of the ulna.
- **Insertion:** into the lower 1/4 of the anterior surface of the radius.
- **Nerve supply:** anterior interosseous branch of the median nerve.
- **Action:**
 1. Pronates the forearm.
 2. Binds the radius to the ulna.

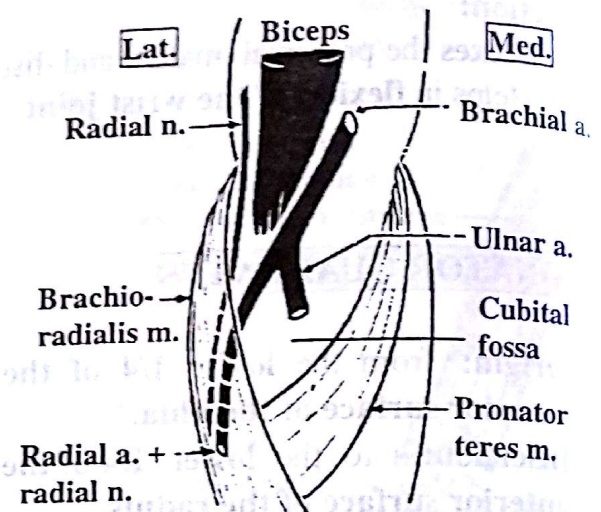


Summary of muscles of the flexor compartment of the forearm

NAME*	ORIGIN	INSERTION	ACTION
Superficial Group			
Pronator teres	Humeral head: medial epicondyle Ulnar head: coronoid process	Middle one third of the lateral border of radius	Pronates forearm
Flexor carpi radialis	Medial epicondyle of humerus	Bases of the second and third metacarpals	Flexes and abducts the hand at the wrist joint
Palmaris longus (often missing)	Medial epicondyle of humerus	Palmar aponeurosis	Flexes the hand at the wrist joint
Flexor digitorum superficialis	Humeral head: medial epicondyle Radial head: coronoid process and oblique line	Middle phalanx of medial four fingers	Flexes the proximal interphalangeal joint and wrist joint
Flexor carpi ulnaris	Humeral head: medial epicondyle Ulnar head: olecranon and posterior border	Pisiform bone, hook of the hamate bone, and base of the fifth metacarpal bone	Flexes and adducts the hand at the wrist joint
Deep Group			
Flexor digitorum profundus	Upper two thirds of anterior ulna and interosseus membrane	Distal phalanx of medial four fingers	Flexes the distal interphalangeal joint and wrist joint
Flexor pollicis longus	Anterior ulna and interosseus membrane	Base of distal phalanx of thumb	Flexes interphalangeal joint of thumb
Pronator quadratus	Anterior surface distal ulna	Anterior surface distal radius	Pronates the forearm

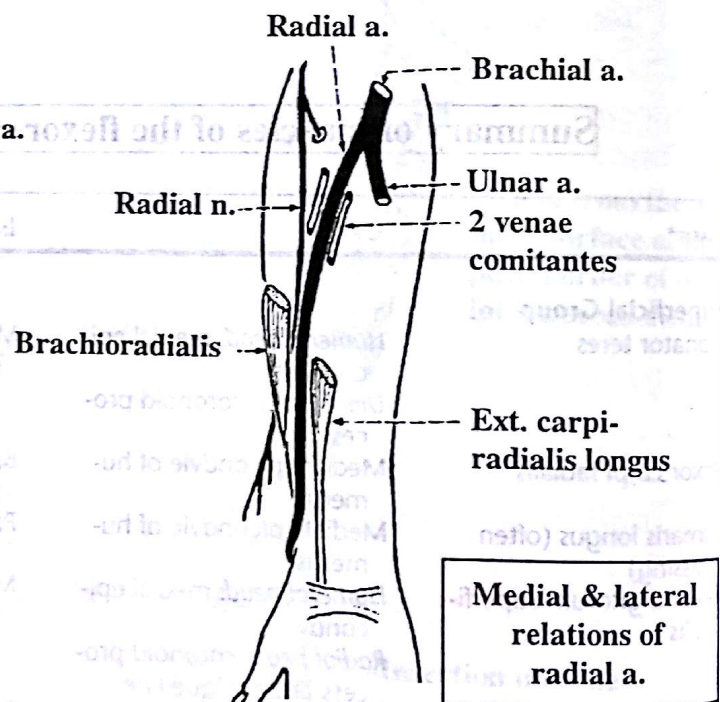
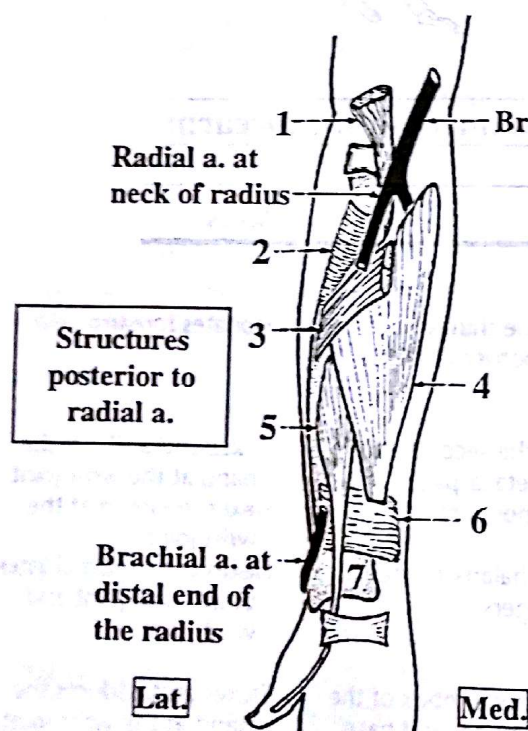
RADIAL ARTERY

- **Origin:** Is the smaller of the two terminal branches of the brachial artery in the cubital fossa.
- Its origin is at the level of the neck of the radius.
- It appears to be the continuation of the brachial artery.
- The artery leaves the cubital fossa at its apex, under cover of the brachioradialis muscle.
- It descends along the lateral side of the front of the forearm down to the wrist.



Course and relations:

- **Anterior (superficial) relations:** (refer to the previous figure)
 - In the upper 2/3 of forearm: the artery descends under cover of the brachioradialis only.
 - In the lower 2/3 of forearm: the artery becomes superficial being only covered by the skin, superficial fascia and deep fascia.



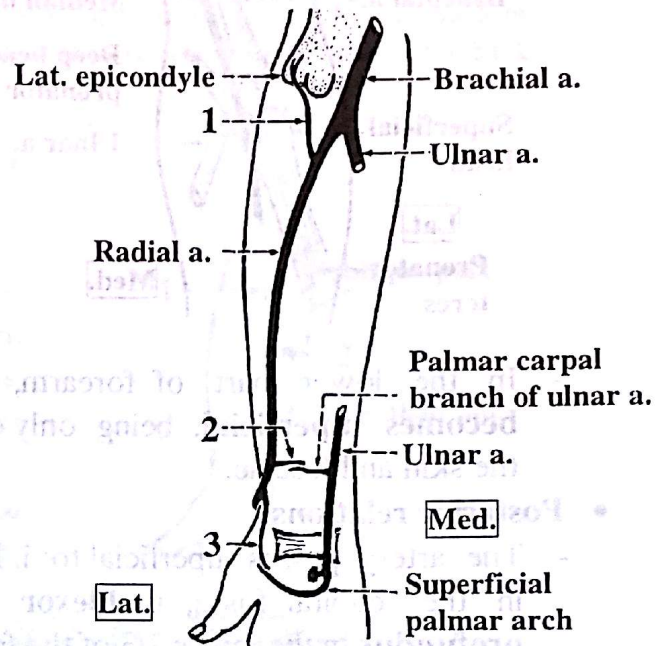
- **Posterior relations:**
 - The artery descends in front of the following structures in order: biceps tendon(1), supinator(2), insertion of pronator teres(3), radial head of flexor digitorum of the radius(7) (at this position the pulsations of the artery can be felt).
- **Laterally:**
 - The radial nerve is closely lateral to the radial artery in the middle 1/3 of forearm.
 - Tendon of brachioradialis muscle lies lateral to the artery in the lower 1/3 of forearm.

- **Medially:**

- The tendon of the **flexor carpi radialis** is closely medial to the **lower third of the radial artery** of the forearm.
- Along its course, the artery is accompanied by two venae comitantes.
(The rest of the course of the radial artery in the back & palm of hand will be described later).

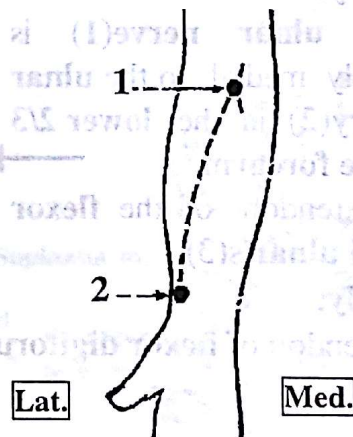
Branches:

1. **Radial recurrent artery:** arises in the cubital fossa, it ascends upwards and **anastomoses with radial collateral branch of profunda brachii artery**, in front of the lateral epicondyle of the humerus.
2. **Anterior (palmar) carpal branch:** it anastomoses with the anterior carpal branch of ulnar artery in front of the wrist to form the anterior carpal arch.
3. **Superficial palmar branch:** arises near the wrist and enters the hand to **anastomoses with the terminal part ulnar artery and form the superficial palmar arch**.
4. **Muscular branches.**



Surface anatomy of radial artery:

- Draw a line extending from the point of termination of brachial artery **midway between the 2 humeral epicondyles(1)** point) to a point in front of the lower end of the radius, where the **radial pulsation can be felt(2)** at the wrist.



ULNAR ARTERY

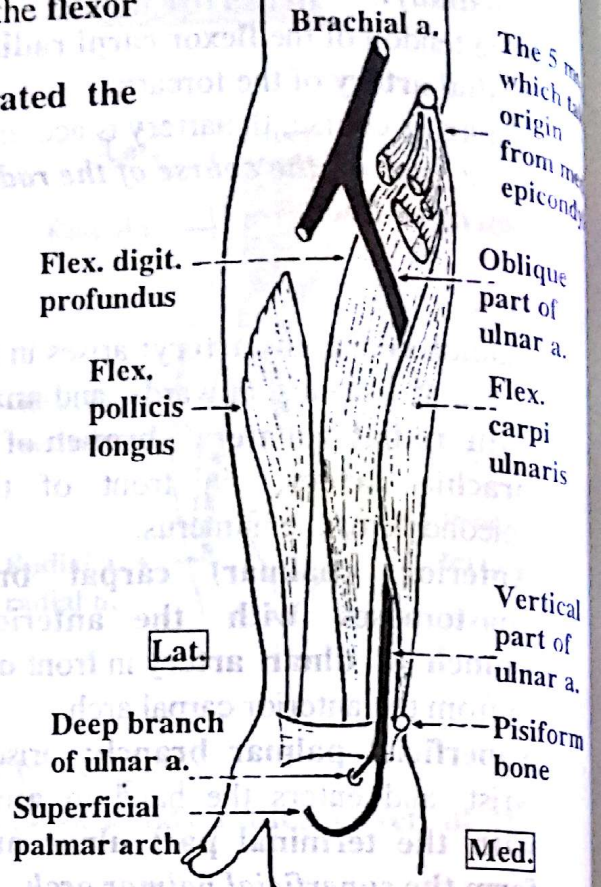
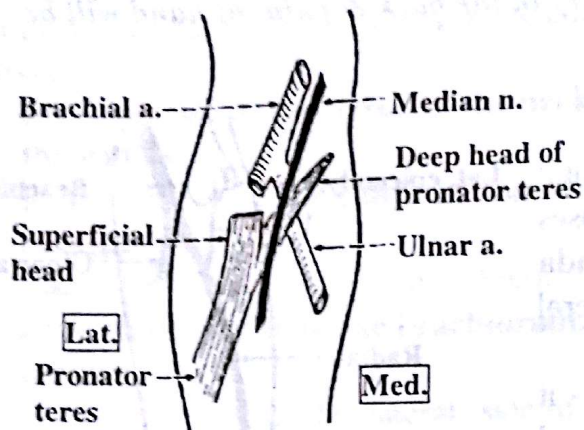


- **Origin:** is the larger of the two terminal branches of the brachial artery.
- It takes origin **at the level of the neck of radius**.
- The artery has **oblique and vertical parts**.
- In the **oblique part:** the artery passes downwards and medially in the **upper third of the forearm**.
- In the **vertical part:** the artery descends along the medial side of the front of the **lower two third of the forearm** down to the wrist.

Course and relations:

- **Anterior relations:** (Refer to Fig. in page 78)
 - The artery at first passes obliquely downwards and medially **deep to the 5 muscles which take origin from the front of the medial epicondyle of the humerus** (pronator teres, flexor carpi radialis, palmaris longus and flexor digitorum superficialis).

- Then the artery descends vertically deep to the flexor carpi ulnaris.
- The deep head of pronator teres separated the artery from the median nerve.



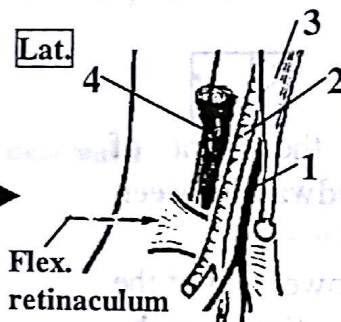
- In the lower part of forearm, the artery becomes superficial, being only covered by the skin and fasciae.

• Posterior relations:

- The artery passes superficial to: i. **Brachialis** in the cubital fossa, ii. **Flexor digitorum profundus** in the lower 2/3 of the forearm.

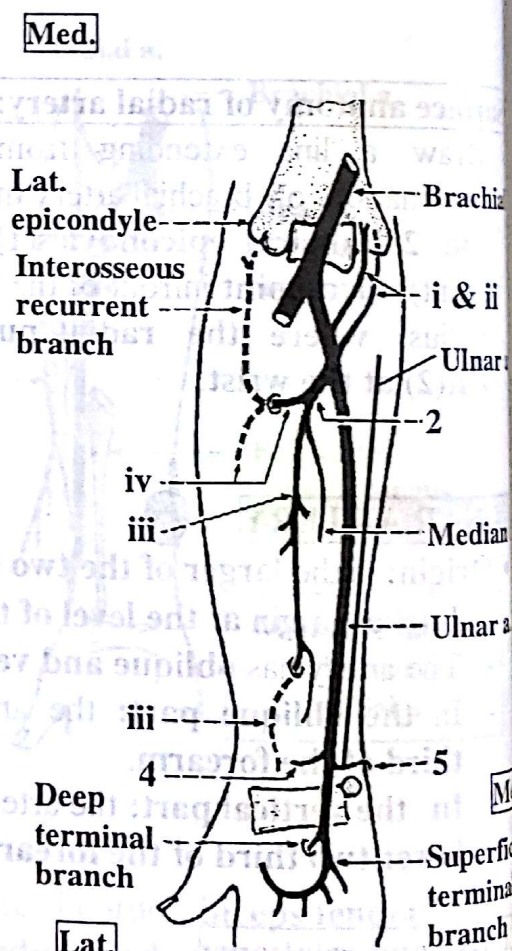
• Medially:

- The **ulnar nerve**(1) is closely medial to the **ulnar artery**(2) in the lower 2/3 of the forearm.
- The tendon of the **flexor carpi ulnaris**(3).



• Laterally:

- The tendon of **flexor digitorum superficialis**(4).



Branches:

1. Ulnar recurrent arteries (anterior and posterior).

i. Anterior ulnar recurrent artery:

anastomoses with the anterior branch of inferior ulnar collateral artery in front of the medial epicondyle of the humerus.

ii. Posterior ulnar recurrent artery:

anastomoses with superior ulnar collateral artery, and posterior branch of inferior ulnar collateral artery behind the medial epicondyle of the humerus.

2. Common interosseous artery: which divides into anterior(iii) and posterior(iv) branches.

3. Muscular branches.

4,5. Anterior and posterior carpal branches: which anastomose with similar branch of radial artery to form the anterior and posterior carpal arches (anastomosis around the wrist).

Some details about common interosseous artery: (Refer to the figure in page 78)

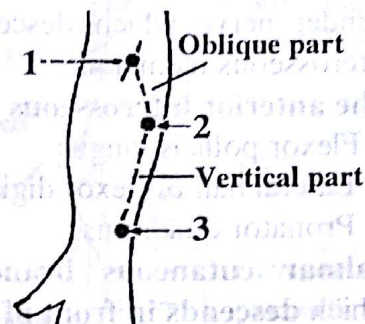
This is a short branch of ulnar artery which divides into two branches:

1. **Posterior interosseous artery:** a small branch which passes above the interosseous membrane to reach the back where it descends to supply muscles. It gives off the **interosseous recurrent artery** which anastomose with the posterior descending the branch of profunda artery at the back of lateral epicondyle.
2. **Anterior interosseous artery:** descends in front of the interosseous membrane with the anterior interosseous nerve.
 - Two inches above the wrist it pierces the interosseous membrane to reach the back of forearm where it descends to the 4th compartments of the extensor retinaculum at the back of the wrist.
 - In the front of the forearm it gives muscular branches and arteries to the radius and ulna.
 - Also it gives off the **median artery** to the median nerve.

Surface anatomy of the ulnar artery:



- a. **Its upper oblique part:** draw a line from the end of the brachial artery [point mid way between the 2 humeral epicondyle(1)], to a point on the medial border of the forearm at the junction of the upper 1/3 and lower 2/3(2).
- b. **Its lower vertical part:** draw a line from the last point to a point just lateral to pisiform bone(3).

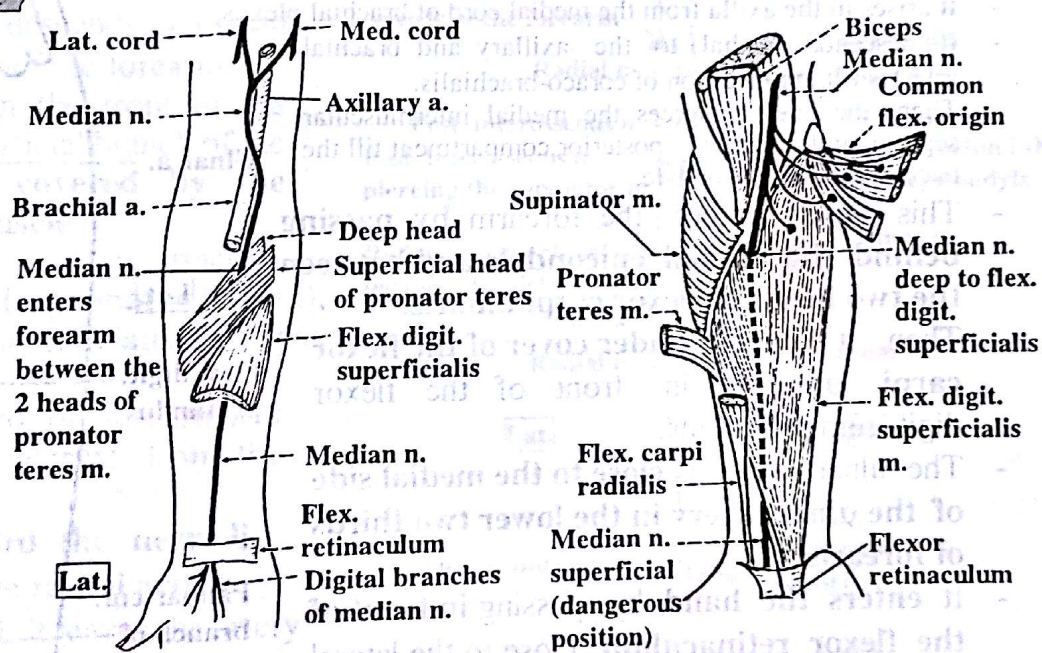


Nerves of the anterior compartment of the forearm

MEDIAN NERVE



- The median nerve arises in the axilla by medial and lateral roots from the medial and lateral cord respectively.
- It descends lateral to the 3rd part of axillary artery and the upper part of brachial artery.
- It then crosses in front of the brachial artery from lateral to medial at the insertion of coraco-brachialis.
- The nerve then it continues its course along the medial side of brachial artery till cubital fossa.



- This nerve enters the forearm by passing between the two heads of pronator teres.
- The deep head of the pronator teres muscle separates the median nerve from the ulnar artery. (Refer to the figure in page 71).
- Then, the nerve descends on the deep surface of the flexor digitorum superficialis, adherent of the fascia of the muscle.
- Above the wrist, the median nerve winds around the lateral side of the tendons of flexor digitorum superficialis and becomes superficial (dangerous position).

(Course of medial nerve in the forearm continued)

- Here, it is covered by the skin superficial fascia and deep fascia and lies close to the medial side of the tendon of flexor carpi radialis.
- It enters the hand by passing deep to the flexor retinaculum.

Branches:

A. Muscular branches to:

1. Pronator teres.
2. Flexor carpi radialis.
3. Palmaris longus.
4. Flexor digitorum superficialis.

B. Anterior interosseous nerve: is a long slender nerve which descends in front of the interosseous membrane.

- The anterior interosseous nerve supplies:
1. Flexor pollicis longus.
 2. Lateral half of flexor digitorum profundus.
 3. Pronator quadratus.

C. Palmar cutaneous branch of median nerve: which descends in front of the flexor retinaculum to supply the skin of the lateral to 2/3 of the palm of hand.

ULNAR NERVE

- It arises in the axilla from the medial cord of brachial plexus.
- It descends medial to the axillary and brachial arteries till the insertion of coraco-brachialis.
- Then the nerve pierces the medial intermuscular septum and enter the posterior compartment till the back of medial epicondyle.
- This nerve enters the forearm by passing behind the medial epicondyle and between the two heads of flexor carpi ulnaris.
- Then, it descends under cover of the flexor carpi ulnaris, in front of the flexor digitorum profundus.
- The ulnar nerve is close to the medial side of the ulnar artery in the lower two thirds of forearm.
- It enters the hand by passing in front of the flexor retinaculum close to the lateral side of the pisiform bone.

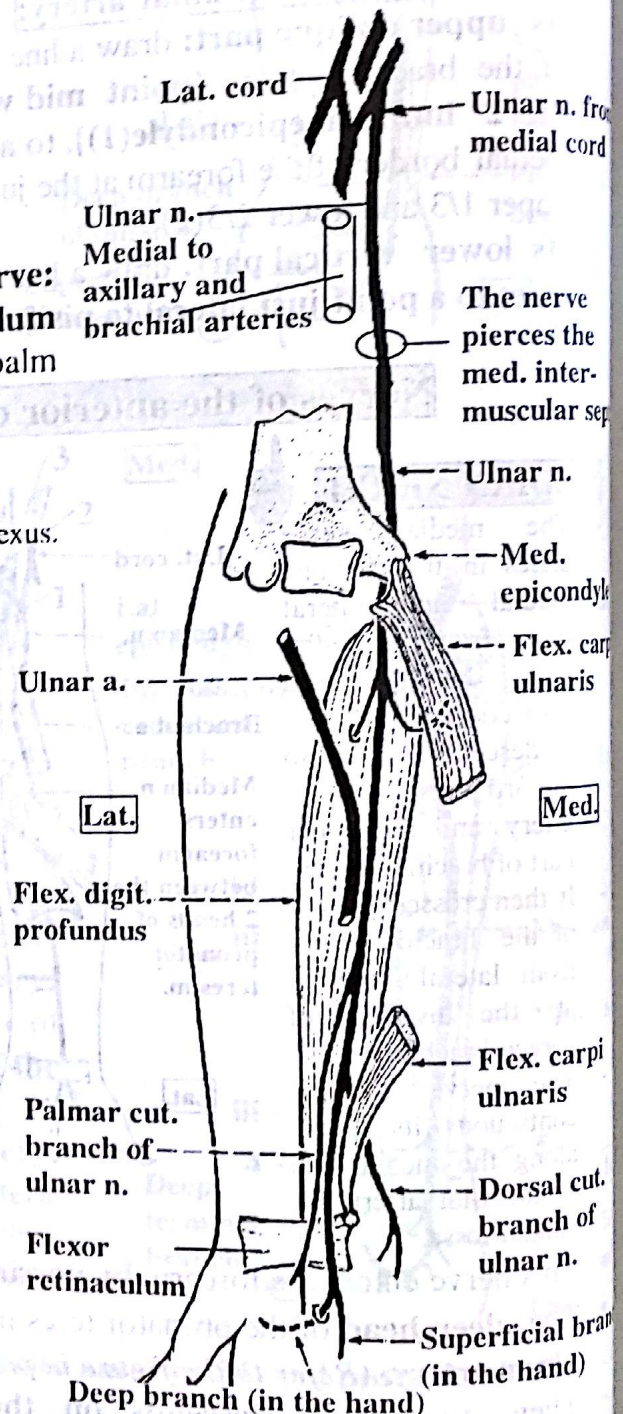
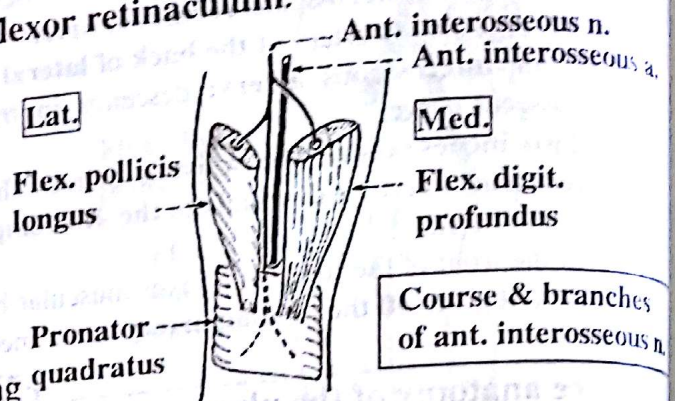
Branches:

A. Muscular branches to:

1. Flexor carpi ulnaris.
2. Medial half of flexor digitorum profundus.

B. Dorsal cutaneous branch: to the medial 1/3 of dorsum of hand and medial 1.5 finger.

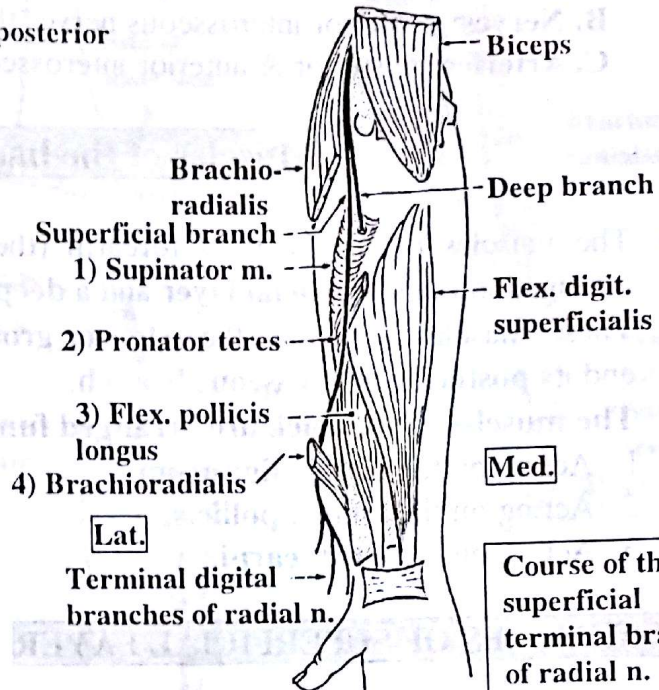
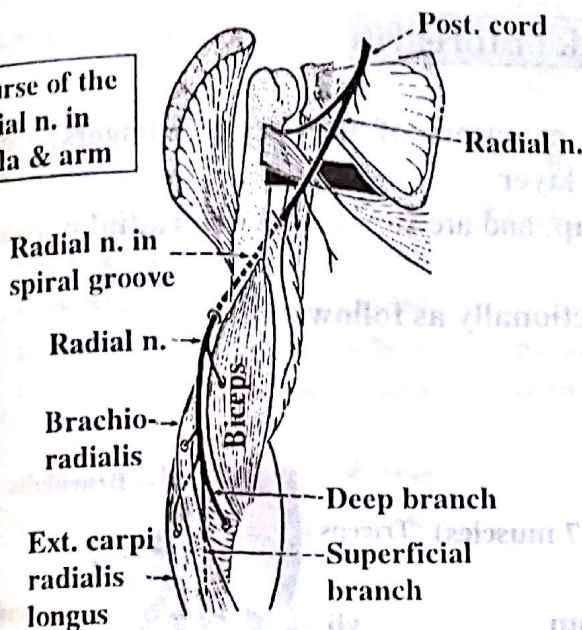
C. Palmar cutaneous branch: which descends in front of the flexor retinaculum to supply the skin of the medial 1/3 of palm of the hand.



RADIAL NERVE

- The nerve arises in axilla from posterior cord of brachial plexus.
- It enters the spiral groove between the long and the medial head of triceps.
- It crosses the spiral groove in the back of the humerus from medial to lateral.
- It emerges on the lateral side of the arm between brachialis medially and brachioradialis and extensor carpi radialis longus laterally.
- Here it divides into superficial and deep (posterior interosseous nerve) branches.

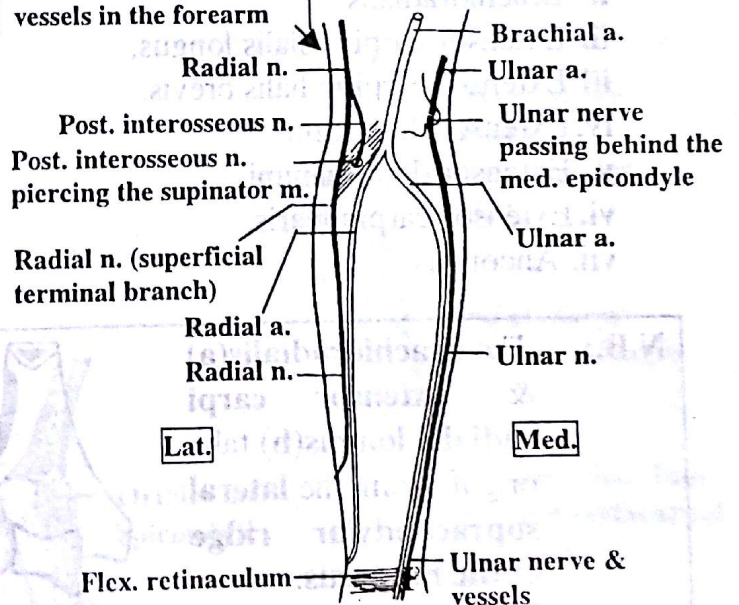
Course of the radial n. in axilla & arm



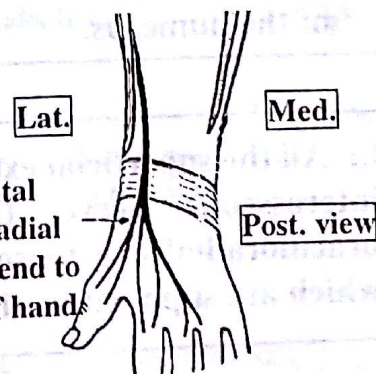
Course of the superficial terminal branch of radial n. in the forearm

- The superficial terminal branch of the radial nerve descends as a small nerve into the front of the forearm.
- As it descends in the front of the forearm, the superficial branch of the radial nerve is covered by the brachioradialis muscle.
- It crosses over 4 muscles attached to radius: supinator(1), pronator teres(2), flexor digitorum superficialis(3), flexor pollicis longus(4).
- In the upper third of forearm it is separated by an interval from the radial artery.
- In the middle third the nerve lies closely lateral to the radial artery.
- In the lower third, it leaves the artery and appears at the posterior border of brachioradialis muscle where it descends to the back of the hand where it supplies the skin on the lateral 2/3 of the dorsum of hand & the dorsum of the lateral 3
- The superficial terminal branch of radial nerve gives no muscular branches in the forearm.

Relations of the radial & ulnar nerves to the vessels in the forearm



Terminal digital branches of radial n. which descend to the dorsum of hand



THE POSTERIOR COMPARTMENT OF THE FOREARM

Contents:

- A. **Muscles:** (superficial & deep layers).
- B. **Nerves:** posterior interosseous nerve (the deep branch of radial nerve).
- C. **Arteries:** posterior & anterior interosseous arteries (branches of ulnar artery).

Muscles of the back of forearm

- The muscles of the back of forearm (the extensors of the wrist & fingers) are arranged into a **superficial layer** and a **deep layer**.
- These muscles constitute the **extensor group**, and are supplied by the **radial nerve** and its **posterior interosseous branch**.
- The muscles of the back are arranged functionally as follows:
 1. Acting on the digits: **digitorum**.
 2. Acting on the thumb: **pollicis**.
 3. Acting on the wrist: **carpi**.

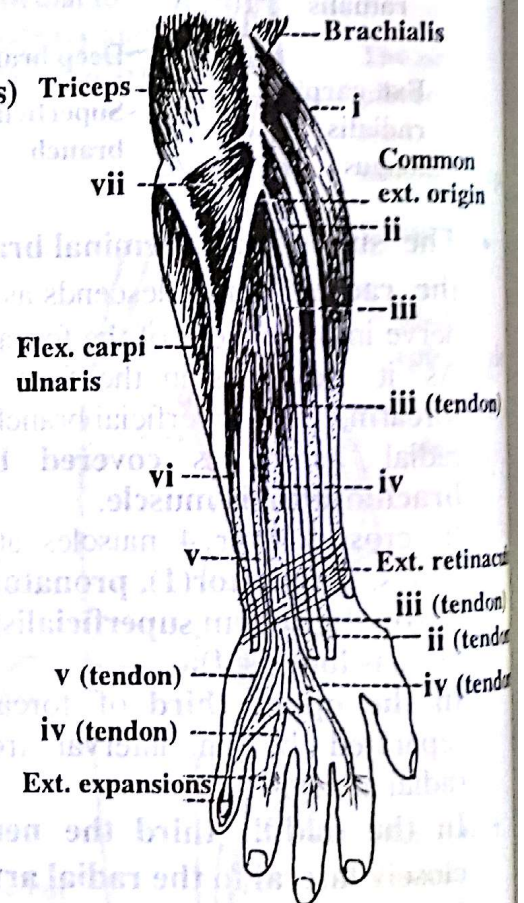
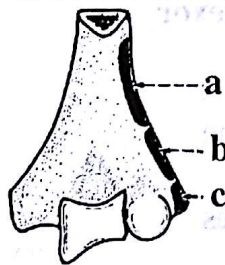
A. MUSCLES OF SUPERFICIAL LAYER (7 muscles)

These are the following as arranged from **lateral to medial**:

- i. Brachioradialis.
- ii. Extensor carpi radialis longus.
- iii. Extensor carpi radialis brevis.
- iv. Extensor digitorum.
- v. Extensor digiti minimi.
- vi. Extensor carpi ulnaris.
- vii. Anconeus.

N.B.: - The brachioradialis(a) & extensor carpi radialis longus(b) take origin from the **lateral supracondylar ridge of the humerus**.

- The other muscles(c) (from iii-vii) have a common origin from the **lateral epicondyle of the humerus**.

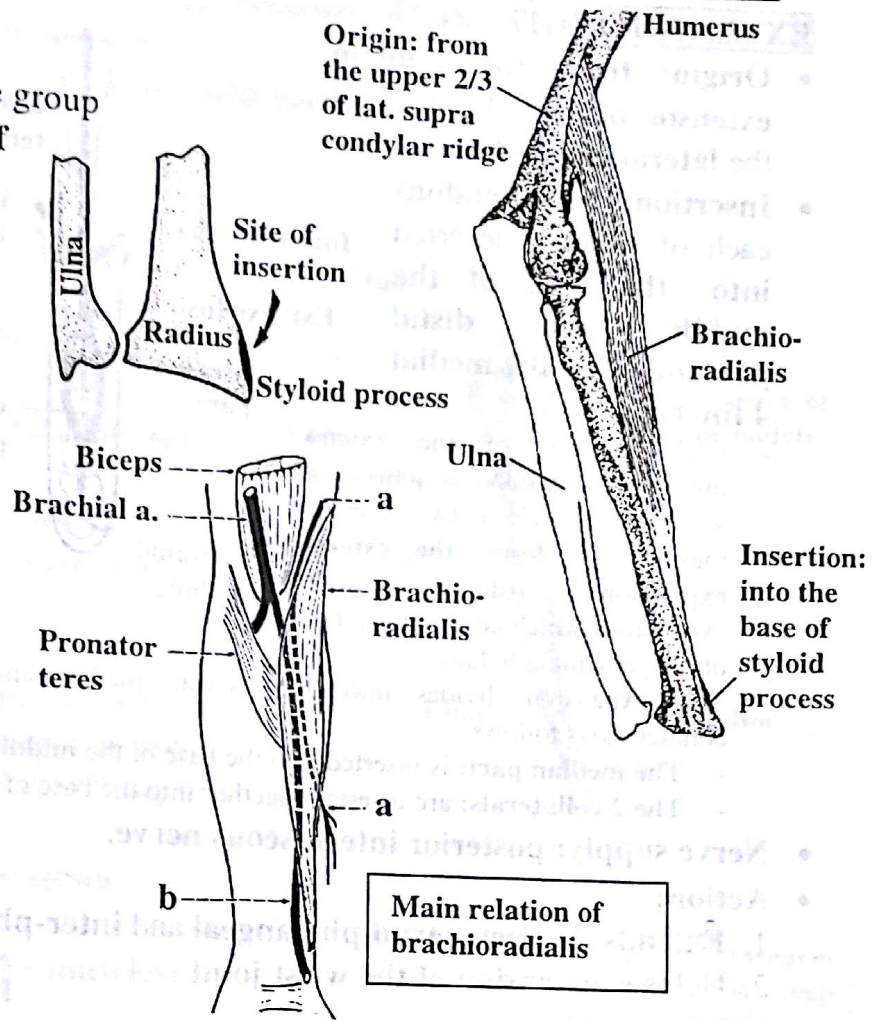


N.B.: All the superficial extensor muscles are supplied by posterior interosseous nerve (branch of the radial nerve) except brachioradialis, extensor carpi radialis longus and anconeus, which are supplied by the radial nerve itself.



It is the most lateral muscle of the group

- **Origin:** from the upper 2/3 of the lateral supracondylar ridge.
- **Insertion:** into the lateral surface of the lower end of the radius (base of the styloid process).
- **Nerve supply:** radial nerve.
- **Action:**
 1. Initiate pronation & supination and brings the forearm in the midprone position (i.e. midway between pronation and supination).
 2. Assists in flexion of the elbow joint in the midprone position.
- **Main relations:**
The radial nerve(a) and radial artery(b) are overlapped by the muscle.



EXTENSOR CARPI RADIALIS LONGUS

Origin: from the lower 1/3 of the lateral supracondylar ridge.

Insertion: into the back of the base of the 2nd metacarpal bone.

Nerve supply: radial nerve.

Action: extends and abducts hand at the wrist joint.

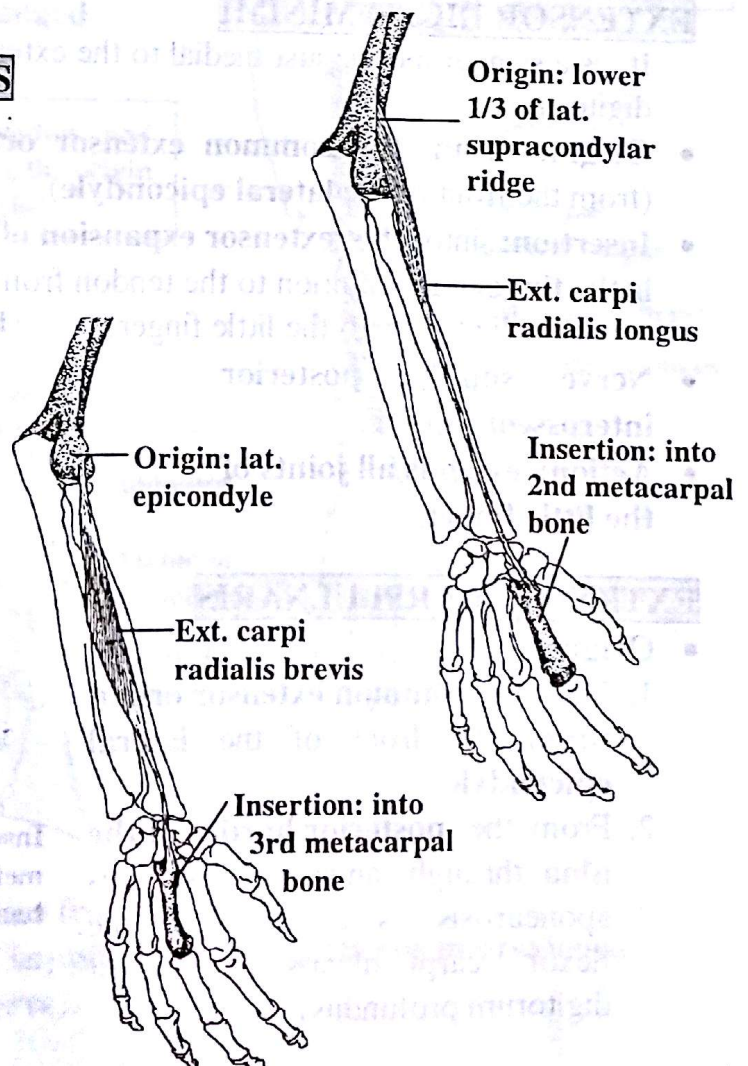
EXTENSOR CARPI RADIALIS BREVIS

Origin: from the common extensor origin which arises from the front of the lateral epicondyle.

Insertion: into the back of the base of the 3rd metacarpal bone.

Nerve supply: posterior interosseous nerve.

Action: extends and abducts hand at the wrist joint.



EXTENSOR DIGITORUM

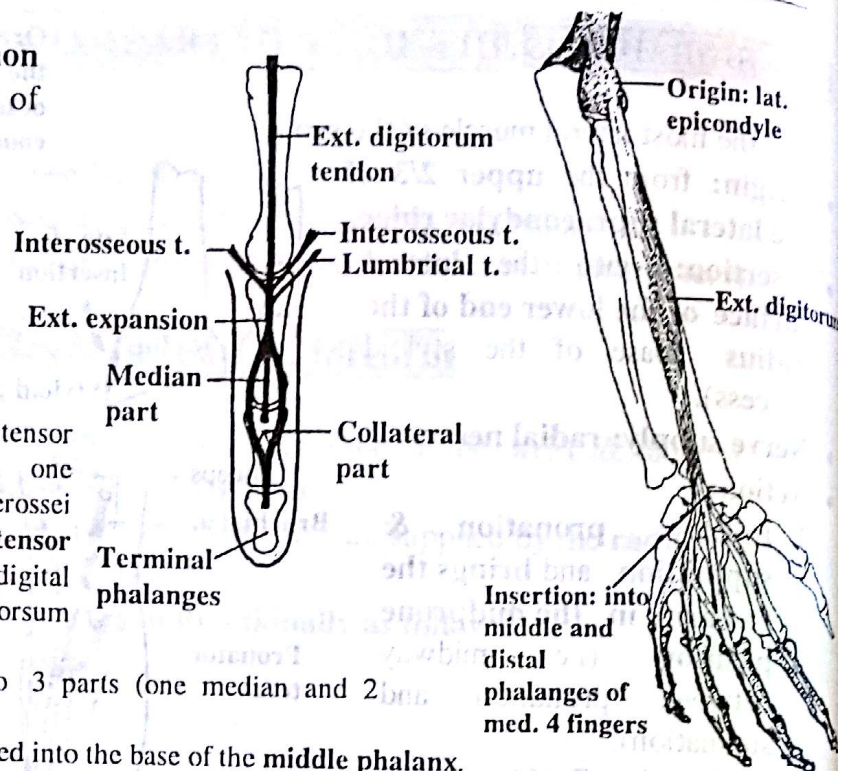
- **Origin:** from the common extensor origin (the front of the lateral epicondyle).
- **Insertion:** by 4 tendons each of which is inserted into the base of the middle and distal phalanges of the medial 4 fingers.

- Each tendon of the extensor digitorum joins one lumbrical muscle + two interossei muscles to form the **extensor expansion** (dorsal digital expansion) which covers the dorsum of the proximal phalanx.
- This expansion divides into 3 parts (one median and 2 collaterals) as follows:
 - **The median part:** is inserted into the base of the middle phalanx.
 - **The 2 collaterals:** are inserted together into the base of the distal phalanx.

- **Nerve supply:** posterior interosseous nerve.

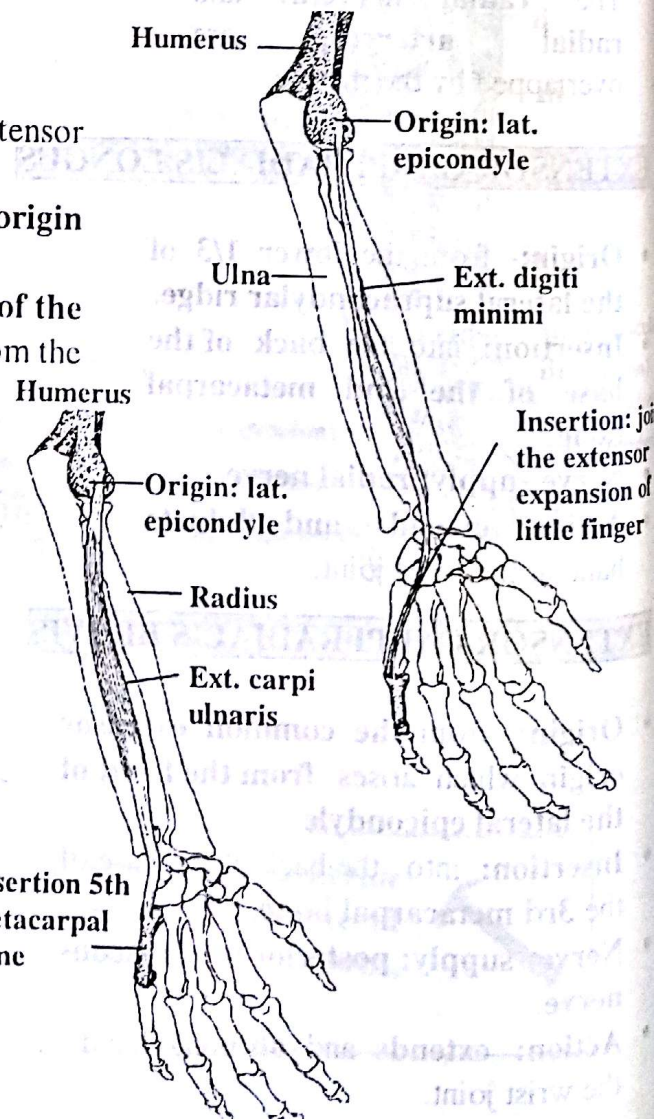
- **Action:**

1. Extends the metacarpo-phalangeal and inter-phalangeal joints.
2. Helps in extension of the wrist joint.

**EXTENSOR DIGITI MINIMI**

It is a slender muscle just medial to the extensor digitorum.

- **Origin:** from the common extensor origin (from the front of the lateral epicondyle).
- **Insertion:** into the extensor expansion of the little finger (in addition to the tendon from the extensor digitorum to the little finger).
- **Nerve supply:** posterior interosseous nerve.
- **Action:** extends all joints of the little finger.

**EXTENSOR CARPI ULNARIS**

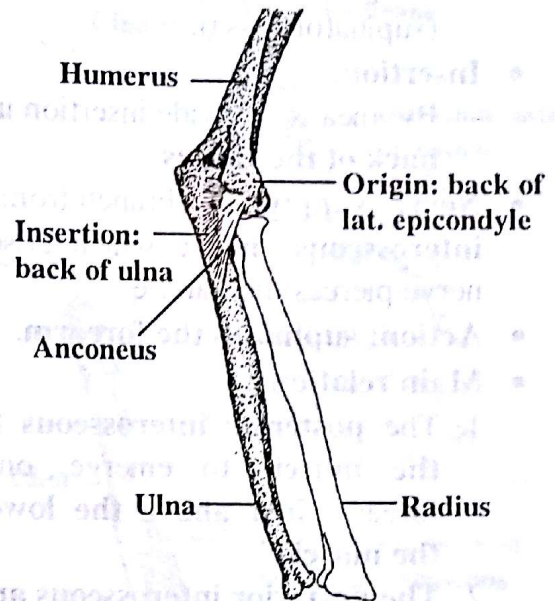
- **Origin:**
 1. From the common extensor origin (from the front of the lateral epicondyle).
 2. From the posterior border of the ulna through an aponeurosis (this aponeurosis is common to the flexor carpi ulnaris and flexor digitorum profundus).

Insertion 5th metacarpal bone

- **Insertion:** into the back of the base of the 5th metacarpal bone.
- **Nerve supply:** posterior interosseous nerve.
- **Action:** extends and adducts the hand at the wrist joint.

ANCONEUS

- It is the most medial muscle of the superficial extensor muscles.
- It is triangular in shape and is the shortest of these muscles.
- **Origin:** from the back of the lateral epicondyle by a rounded tendon.
- **Insertion:** into the lateral surface of the olecranon and upper 1/4 of the back of the shaft of the ulna, above the oblique upper part of the posterior border.
- **Nerve supply:** by a branch from the radial nerve which arises in the spiral groove and descends through the medial head of triceps to reach the anconeus.
- **Action:** helps in extension of the elbow.



B. MUSCLES OF DEEP LAYER (5 muscles)

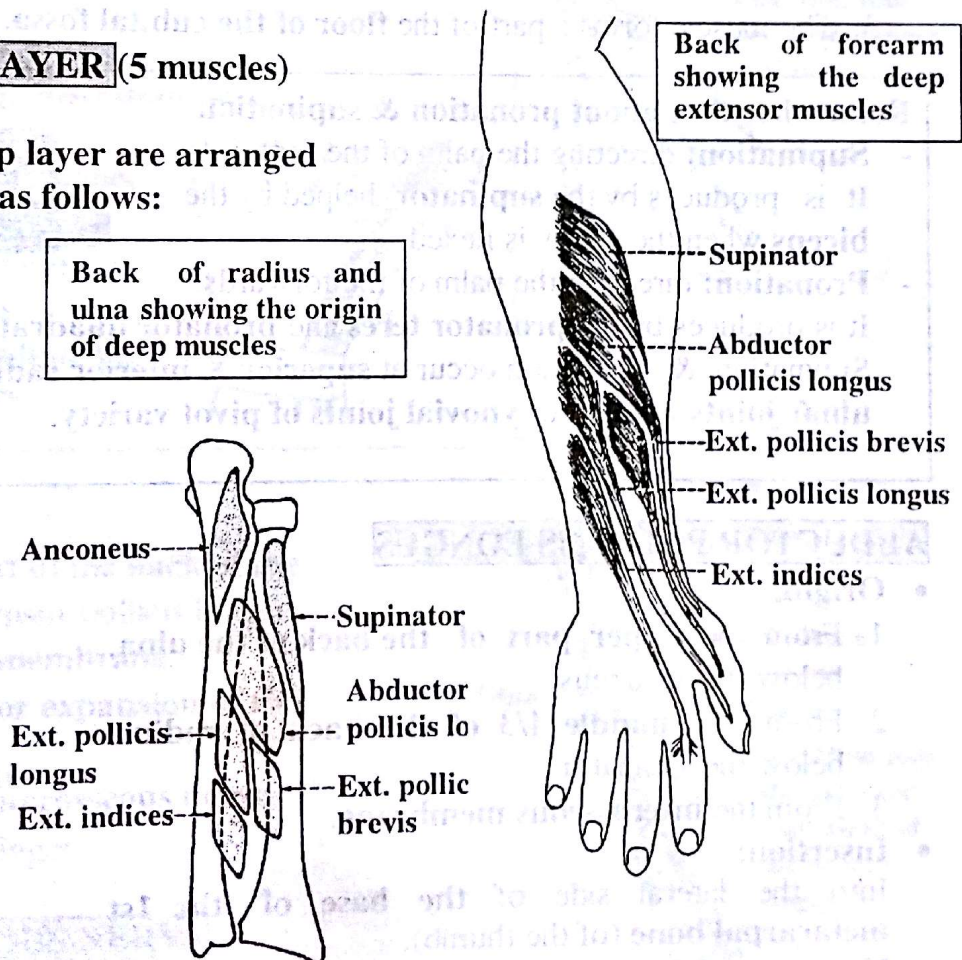
The muscles of the deep layer are arranged from above downwards as follows:

1. **Supinator:** the highest and is attached to both radius and ulna.

2. **Abductor pollicis longus:** arises from both radius and ulna just below the supinator.

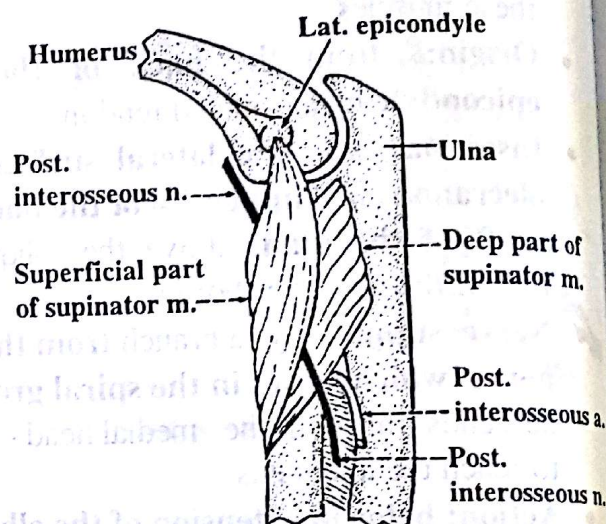
3,4. **The 2 extensors of the thumb:** the extensor pollicis longus (from the ulna), and extensor pollicis brevis (from the radius). The 2 muscles lie side by side.

5. **Extensor indices:** is the lowest and arises from the ulna. All the deep extensor muscles are supplied by the posterior interosseous nerve (deep branches of the radial nerve).



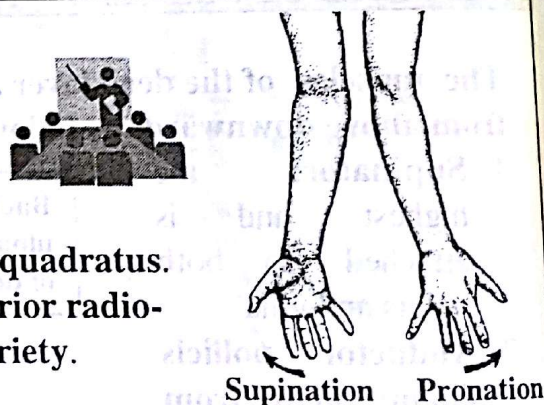
SUPINATOR

- **Origin: (2 parts)**
 1. **Superficial part:** from the lateral epicondyle and the radial collateral ligament of the elbow joint.
 2. **Deep part:** from the supinator crest and the depression just in front (supinator fossa).
- **Insertion:**
 - By means of wide insertion into the upper 1/3 of the front, lateral surface and back of the radius.
- **Nerve supply:** by a branch from the posterior interosseous nerve which arises before the nerve pierces the muscle.
- **Action:** supinates the forearm.
- **Main relations:**
 1. The posterior interosseous nerve pierces the muscle to emerge on the back of forearm just above the lower border of the muscle.
 2. The posterior interosseous artery appears on the back of forearm just below the lower border of the muscle.
 3. The muscle forms a part of the floor of the cubital fossa.



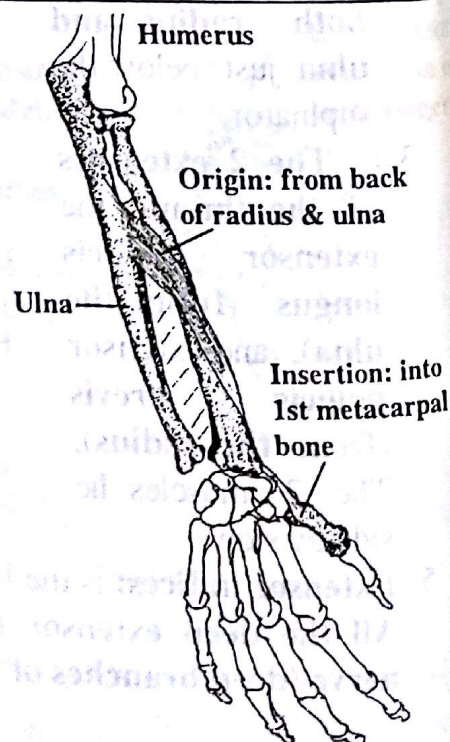
Remember that about pronation & supination

- **Supination:** directing the palm of the forwards. It is produced by the supinator, helped by the biceps when the elbow is flexed.
- **Pronation:** directing the palm of the backwards. It is produced by the pronator teres and pronator quadratus. Supination & pronation occur at superior & inferior radio-ulnar joints which are synovial joints of pivot variety.



ABDUCTOR POLLICIS LONGUS

- **Origin:**
 1. From the upper part of the back of the ulna, below the anconeus.
 2. From the middle 1/3 of the back of radius, below the supinator.
 3. From the interosseous membrane.
- **Insertion:** Into the lateral side of the base of the 1st metacarpal bone (of the thumb).
- **Nerve supply:** posterior interosseous nerve.
- **Action:**
 1. Abducts & extends the carpo-metacarpal joint of the thumb.
 2. Helps in abduction of the wrist joint.



EXTENSOR POLLICIS BREVIS

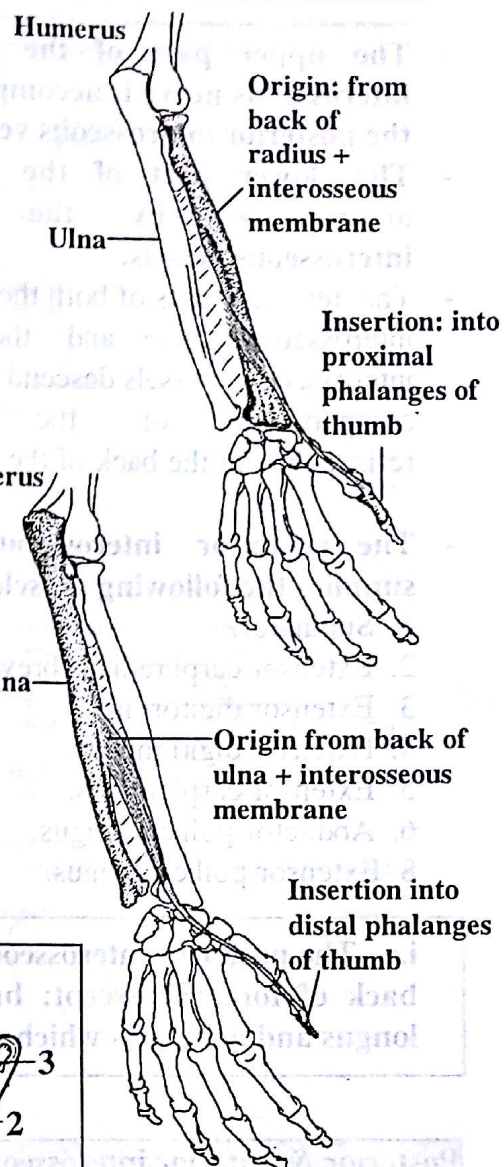
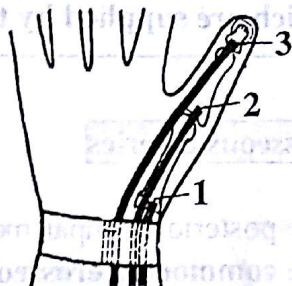
- **Origin:** from the middle 1/3 of the back of the radius, just below the abductor pollicis longus and from the interosseous membrane.
- **Insertion:** into the base of the proximal phalanx of the thumb.
- **Nerve supply:** posterior interosseous nerve.
- **Action:** extends the metacarpo-phalangeal joint of the thumb.

EXTENSOR POLLICIS LONGUS

- **Origin:** from the middle 1/3 of the back of the ulna, and from the interosseous membrane, just below the abductor pollicis longus.
- **Insertion:** into the back of the base of the distal phalanx of the thumb. The tendon winds laterally round the dorsal tubercle on the back of the lower end of the radius.
- **Action:** extends all the joints of the thumb.

Remember the following insertions into the thumb.

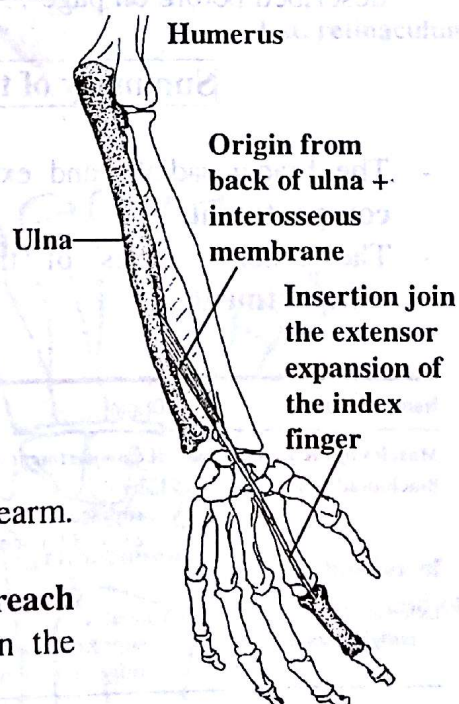
- (1) Base of metacarpal bone: abductor pollicis longus.
- (2) Base of proximal phalanx: extensor pollicis brevis.
- (3) Base of distal phalanx: extensor pollicis longus.

**EXTENSOR INDICIS**

- **Origin:** from the lower part of the back of the ulna, just below the extensor pollicis longus, and from the interosseous membrane.
- **Insertion:** into the extensor expansion of the index finger.
- **Nerve supply:** posterior interosseous nerve.
- **Action:** extends the index finger.

POSTERIOR INTEROSSEOUS NERVE

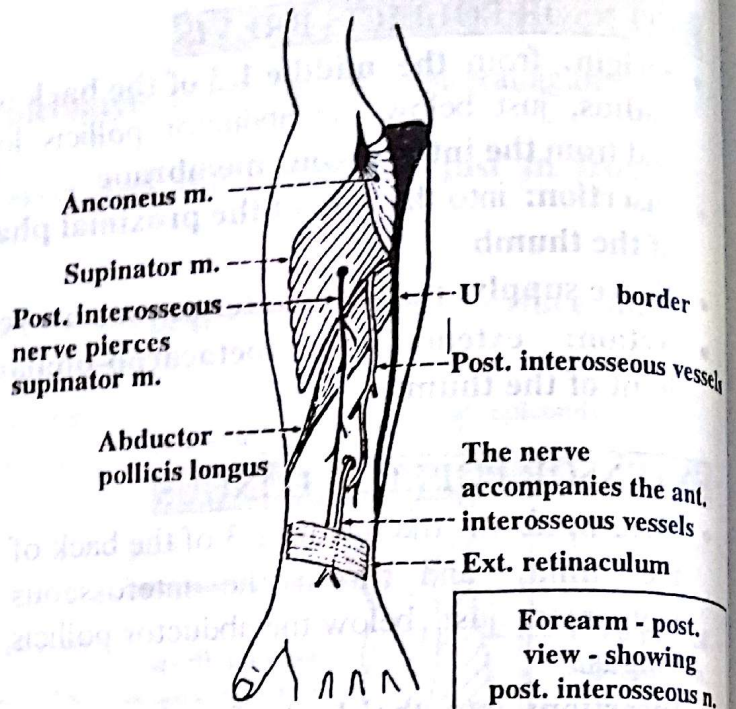
- It is the only nerve in the posterior compartment of the forearm.
- This is the deep terminal branch of radial nerve.
- In front of the elbow it pierced the supinator muscle to reach the back of the forearm where it passes between the superficial and deep muscles of the back.



- The upper part of the posterior interosseous nerve is accompanied by the posterior interosseous vessels.
- The lower part of the nerve is accompanied by the anterior interosseous vessels.
- The terminal parts of both the posterior interosseous nerve and the anterior interosseous vessels descend to the 4th compartment of the extensor retinaculum at the back of the wrist.

- The posterior interosseous nerve supplies the following muscles:

1. Supinator.
2. Extensor carpi radialis brevis.
3. Extensor digitorum.
4. Extensor digiti minimi.
5. Extensor carpi ulnaris.
6. Abductor pollicis longus.
7. Extensor pollicis brevis.
8. Extensor pollicis longus.
9. Extensor indicis.



i.e. The posterior interosseous nerve supplies all the muscles of the back of forearm except: brachioradialis, extensor carpi radialis longus and anconeus which are supplied by the radial nerve.



Posterior & anterior interosseous arteries

- They are the arteries of the posterior compartment of the forearm.
- **Both are branches of the common interosseous artery** - branch of the ulnar artery described before on page 79.

Summary of the muscle of the back of the forearm

- The brachioradialis and extensor carpi radialis longus form a special **lateral fascial compartment**.
- The other muscles of the back of the forearm form the **posterior fascial compartment**.

Name of Muscle	Origin	Insertion	Nerve Supply	Action
Muscles of the Lateral Fascial Compartment of the Forearm				
Brachioradialis	Lateral supracondylar ridge of humerus	Base of styloid process of radius	Radial nerve	Flexes forearm at elbow joint; rotates forearm to the midprone position
Extensor carpi radialis longus	Lateral supracondylar ridge of humerus	Posterior surface of base of second metacarpal bone	Radial nerve	Extends and abducts hand at wrist joint

Name of Muscle	Origin	Insertion	Nerve Supply	Action
Muscles of the Posterior Fascial Compartment				
Extensor carpi radialis brevis	Lateral epicondyle of humerus	Posterior surface of base of third metacarpal bone	Deep branch of radial nerve	Extends and abducts hand at wrist joint
Extensor digitorum	Lateral epicondyle of humerus	Middle and distal phalanges of the medial four fingers	Deep branch of radial nerve	Extends fingers and hand (see text for details)
Extensor digiti minimi	Lateral epicondyle of humerus	Extensor expansion of little finger	Deep branch of radial nerve	Extends metacarpal phalangeal joint of little finger
Extensor carpi ulnaris	Lateral epicondyle of humerus	Base of fifth metacarpal bone	Deep branch of radial nerve	Extends and adducts hand at wrist joint
Anconeus	Lateral epicondyle of humerus	Lateral surface of olecranon process of ulna	Radial nerve	Extends elbow joint
Supinator	Lateral epicondyle of humerus, annular ligament of proximal radioulnar joint, and ulna	Neck and shaft of radius	Deep branch of radial nerve	Supination of forearm
Abductor pollicis longus	Posterior surface of shafts of radius and ulna	Base of first metacarpal bone	Deep branch of radial nerve	Abducts and extends thumb
Extensor pollicis brevis	Posterior surface of shaft of radius	Base of proximal phalanx of thumb	Deep branch of radial nerve	Extends metacarpophalangeal joints of thumb
Extensor pollicis longus	Posterior surface of shaft of ulna	Base of distal phalanx of thumb	Deep branch of radial nerve	Extends distal phalanx of thumb
Extensor indicis	Posterior surface of shaft of ulna	Extensor expansion of index finger	Deep branch of radial nerve	Extends metacarpophalangeal joint of index finger

EXTENSOR RETINACULUM



- It is a thick fibrous band which extends obliquely across the back of the wrist.

ATTACHMENTS:

The extensor retinaculum is attached mainly to the radius and ulna, as follows:

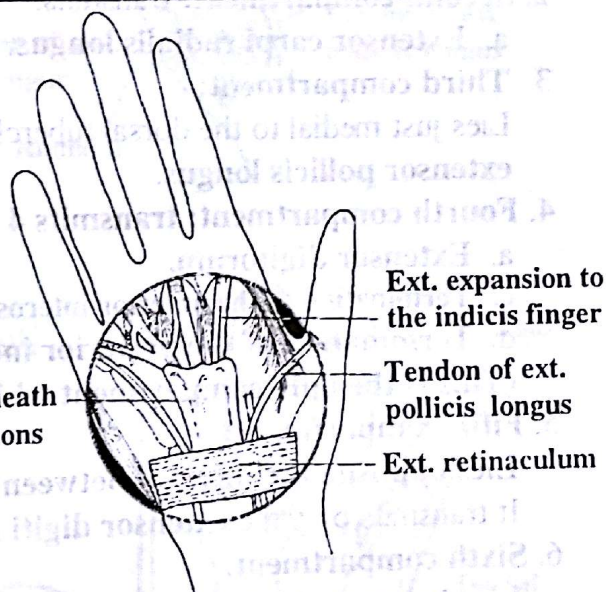
- **Medially:** to the **styloid process of the ulna**, in addition to the **triquetral** and **pisiform bones**.
- **Laterally:** to the **anterior border of the lower end of the radius**.

RELATIONS:

- **Superficial relations:**

1. **Beginning of cephalic vein:** laterally.
2. **Beginning of basilic vein:** medially.
3. **Termination of radial nerve:** in between.

Synovial sheath of ext. tendons



Med.

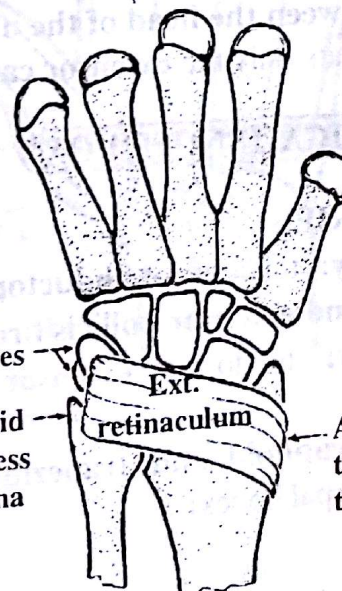
Lat.

Attachments of ext. retinaculum

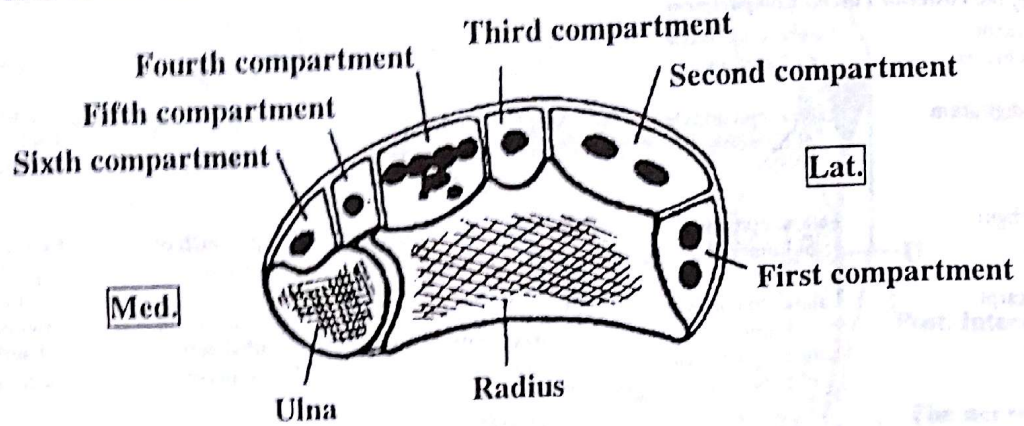
Triquetral + pisiform bones
Styloid process of ulna

Ext. retinaculum

Ant. border of the lower end of the radius



- **Deep relations of extensor retinaculum:**



- Five septa extend from the deep surface of the retinaculum to the lower end of the radius and ulna, thus **forming 6 compartments**.
- 4 compartments on the radius, 1 compartment between radius and ulna & 1 compartment on the ulna.
- These compartments are arranged from lateral to medial as follows:

1. **First compartment:** (most lateral)

Lies on the lateral surface of the lower end of the radius, and **transmits** the following tendons:

- a. Abductor pollicis longus.
- b. Extensor pollicis brevis.

2. **Second compartment:** transmits:

- a. Extensor carpi radialis longus.
- b. Extensor carpi radialis brevis.

3. **Third compartment:**

Lies just medial to the dorsal tubercle of the radius, and **transmits** only the tendon of extensor pollicis longus.

4. **Fourth compartment:** transmits 4 structures:

- a. Extensor digitorum.
- b. Extensor indicis.
- c. Termination of the anterior interosseous artery.
- d. Termination of the posterior interosseous nerve.

(This is the only compartment which transmits a nerve and an artery).

5. **Fifth compartment:**

Lies opposite the interval between the radius and head of the ulna.

It transmits only the extensor digiti minimi.

6. **Sixth compartment:**

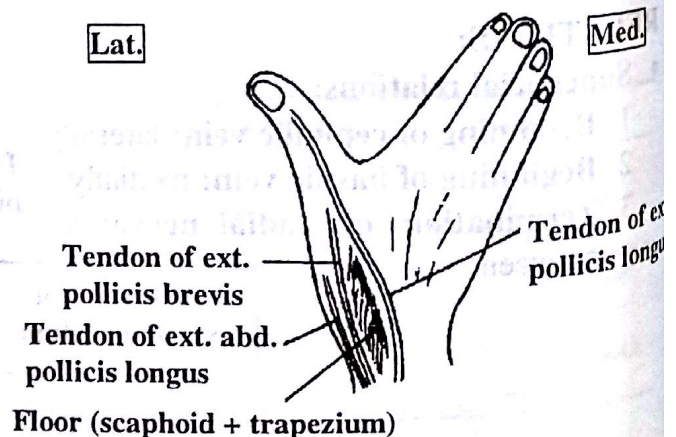
Lies between the head of the ulna and its styloid process.

It transmits only the extensor carpi ulnaris.

ANATOMICAL SNUFF-BOX

BOUNDARIES

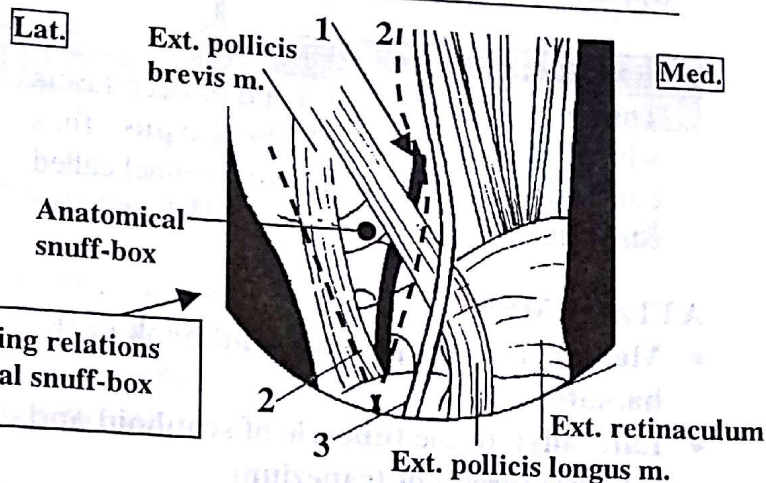
- **Laterally:** tendons of abductor pollicis longus and extensor pollicis brevis.
- **Medially:** tendon of extensor pollicis longus.
- **Floor:** scaphoid and trapezium (most lateral carpal bones).



RELATIONS:

1. **Radial artery:** passes on its floor (the only content).
2. **Digital branches of radial nerve:** descend in its roof.
3. **Cephalic vein:** ascends in its roof.

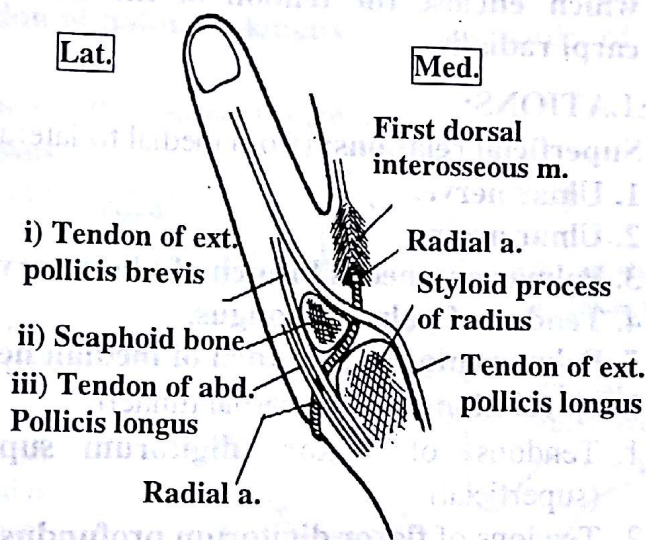
Dorsum of the hand showing relations and contents of anatomical snuff-box

**ARTERIES IN THE DORSUM OF THE HAND****1. The radial artery:**

- The radial artery winds backwards on the lateral side of the wrist.
- It passes in the floor of the anatomical snuff-box.
- It then passes between the two heads of first dorsal interosseous muscle to reach the palm of the hand.

Lat.

Med.

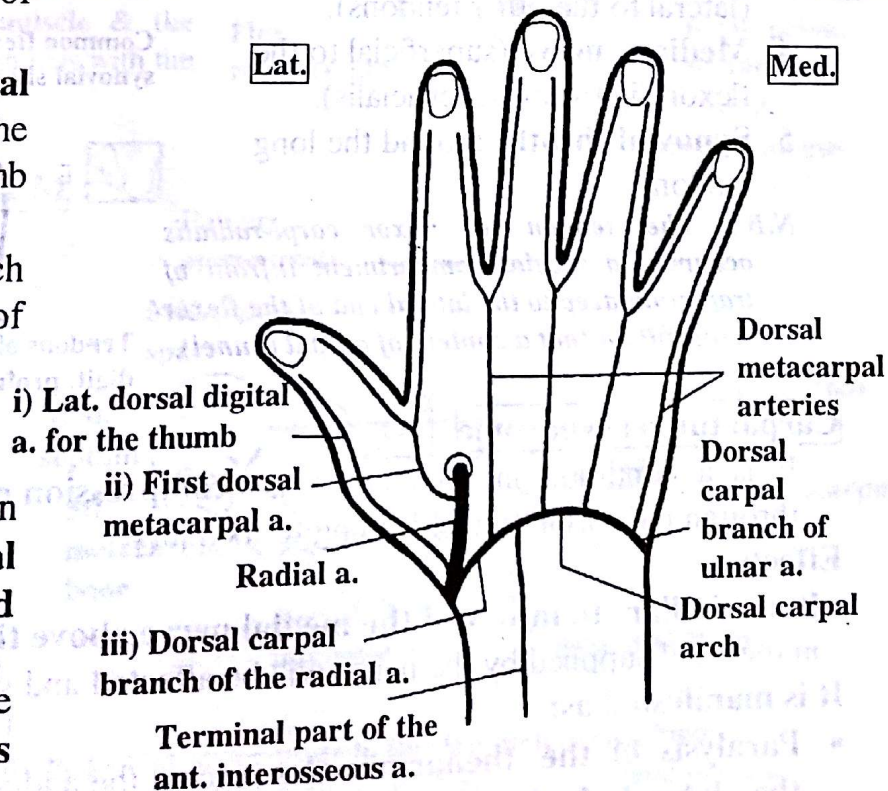


- In the dorsum of the hand the radial artery gives:

- i) **Lateral dorsal digital branch** to the lateral side of the thumb,
- ii) **The first dorsal metacarpal artery** which supplies the adjacent sides of the thumb and index finger,
- iii) **Dorsal carpal branch** which share in the formation of dorsal carpal arch.

Lat.

Med.

**2. Dorsal carpal arch:**

- This arch is formed by the union of the two dorsal carpal branches of the radial and ulnar arteries.
- The arch lies deep to the extensor tendons and gives dorsal metacarpal arteries for the dorsum of the medial three and half fingers.

FLEXOR RETINACULUM

This is a thick fibrous band of deep fascia which lies in front of the carpus, thus converting its concavity into a tunnel called carpal tunnel.

ATTACHMENTS:

- Medially: to the pisiform and hook of the hamate.
- Laterally: to the tubercle of scaphoid and tubercle (crest) of trapezium.
- * At its lateral attachment the retinaculum is splitted into superficial and deep laminae which enclose the tendon of the flexor carpi radialis.

RELATIONS:

- Superficial relations: (from medial to lateral).
 1. Ulnar nerve.
 2. Ulnar artery.
 3. Palmar cutaneous branch of ulnar nerve.
 4. Tendon of palmaris longus.
 5. Palmar cutaneous branch of median nerve.
- Deep relations: (inside carpal tunnel).
 1. Tendons of flexor digitorum superficialis (superficial).
 2. Tendons of flexor digitorum profundus (deep).
 3. Tendon of flexor pollicis longus (lateral to the other tendons).
 4. Median nerve (superficial to the flexor digitorum superficialis).
 5. Synovial sheaths around the long tendons.

N.B.: The tendon of flexor carpi-radialis occupies a special compartment in front of trapezium deep to the lateral end of the flexor retinaculum (not a content of carpal tunnel).

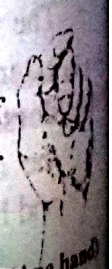
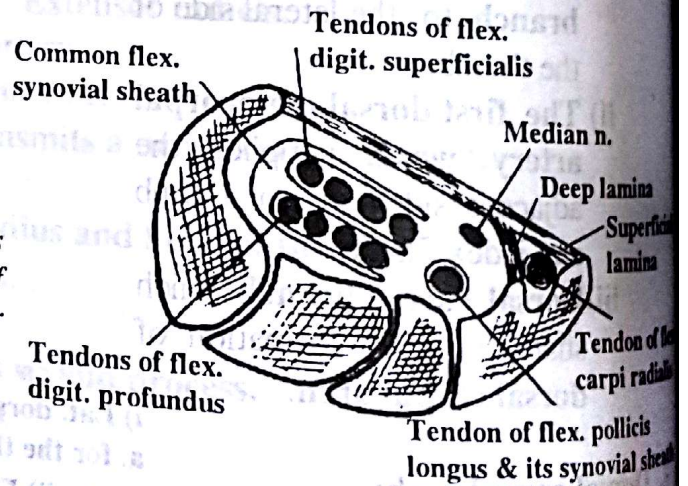
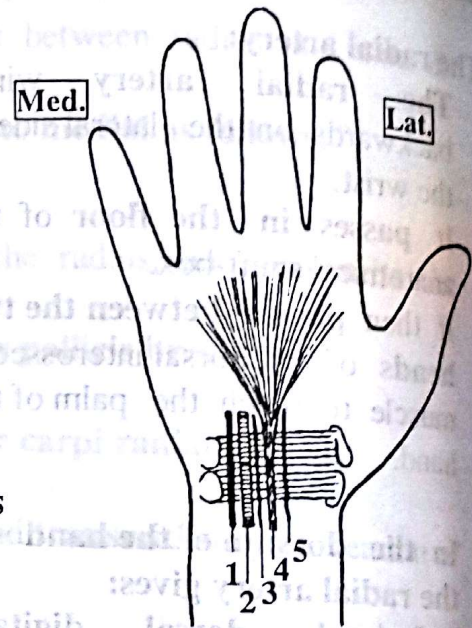
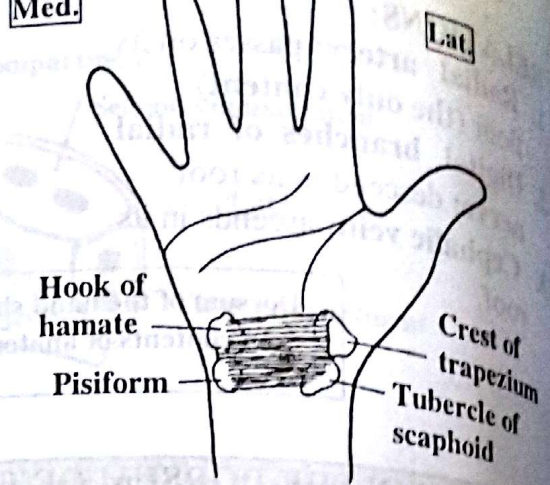
Carpal tunnel syndrome



It is a condition in which there is a compression of the medial nerve as it passes through the carpal tunnel leading to its injury.

Effects:

- It is similar to injury of the medial nerve above the wrist (ape hand), so all the muscles in the hand supplied by the nerve will be affected and skin will lose its sensations.
- It is manifested as:
 - Paralysis of the thenar muscles (except the adductor pollicis) + paralysis of the lateral 2 lumbrical muscles will lead to > i) atrophy of thenar eminence, ii) adduction of the thumb, iii) hyper extension of the thumb.
 - Affection of the sensations in the lateral 3.5 fingers.



DEEP FASCIA OF THE PALM:

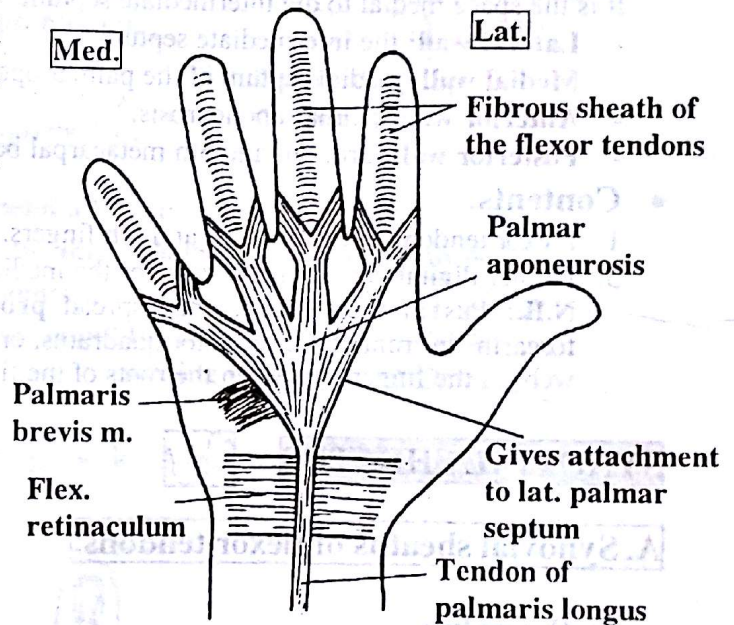
The deep fascia of the palm of the hand consists of 3 parts: lateral medial and central.

1. **Lateral part:** thin and covers the thenar eminence.
2. **Medial part:** thin and covers the hypothenar eminence.
3. **Central part:** thick and triangular and covers the intermediate compartment of the hand. It is called the **palmar aponeurosis**.

PALMAR APONEUROSIS:



- It is **triangular** in shape with an **apex** directed proximally and a base directed distally.
- The **apex** is continuous with the **tendon of palmaris longus** and distal border of the **flexor retinaculum**.
- The **base** divides into **4 slips**, one for each of the medial 4 fingers.
- Each **slip** divides into **two processes** which diverge on the sides of the finger and with the deep fascia on the dorsum of the finger.
- The distal borders of the two slips are continuous with the **fibrous flexor** of the finger.
- The **lateral margin** of the aponeurosis gives attachment to the **lateral palmar septum**, and is continuous with the deep fascia of the thenar eminence.
- The **medial margin** of the aponeurosis gives attachment to **palmaris brevis muscle** & the **medial palmar septum**, and is continuous with the deep fascia of the hypothenar eminence.



FASCIAL SPACES OF THE PALM

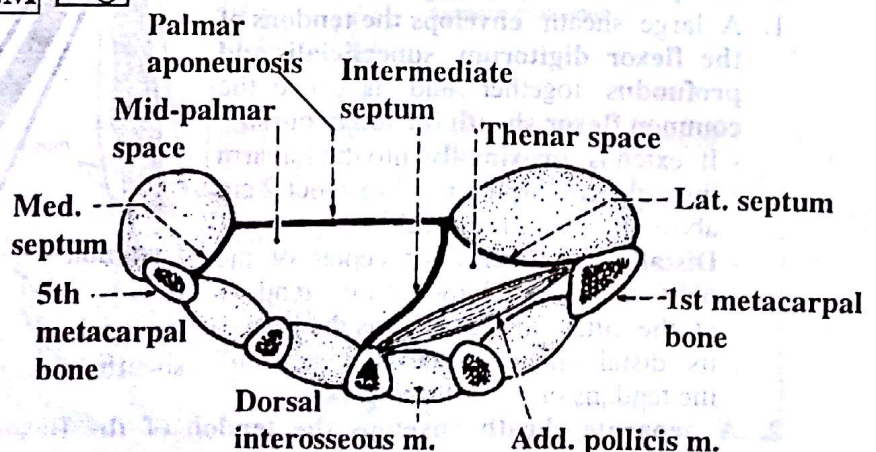


- The central part of the palm is bounded by the **palmar aponeurosis** which forms its roof and by the **medial and lateral septa** which form its sides.

- The central part is subdivided by an **intermediate septum** into 2 spaces called:

1. **Thenar space (laterally)** and
2. **Mid-palmar space (medially).**

- This **intermediate septum** extends from the **palmar aponeurosis** to the **3rd metacarpal bone**.
- The intermediate septum intervenes between the tendons of the index finger on its lateral side and tendons of the medial 3 fingers on its medial side.
- This means that the tendons of the index finger lie in the **thenar space** while the tendons of the medial 3 fingers lie in the **mid-palmar space**.



1. THENAR SPACE:



• Boundaries:

It is the space lateral to the intermediate septum. It has the following walls.

- **Medial wall:** the intermediate septum.
- **Lateral wall:** lateral septum of the palmar aponeurosis.
- **Anterior wall:** palmar aponeurosis.
- **Posterior wall:** adductor pollicis and covering fascia.

• Contents:

1. Tendon of the flexor pollicis longus.
2. Flexor tendons of the index finger (one superficialis and one profundus).
3. Palmar digital nerves and vessels to the thumb and index fingers.

Communication between the thenar space & web of thumb

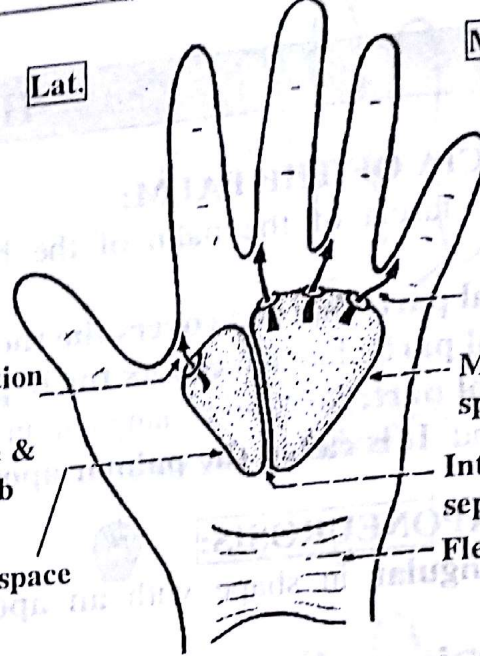
Thenar space

Communication between the med. palmar space and the webs between the med. 4 fingers

Med. palmar space

Intermediate septum

Flex. retinaculum



2. MIDPALMAR SPACE:



• Boundaries:

It is the space medial to the intermediate septum. It has the following walls:

- **Lateral wall:** the intermediate septum.
- **Medial wall:** medial septum of the palmar aponeurosis.
- **Anterior wall:** palmar aponeurosis.
- **Posterior wall:** 3rd, 4th and 5th metacarpal bones and related interosseous muscles.

• Contents:

1. Flexor tendons of the 3rd, 4th and 5th fingers.
2. Superficial palmar arch.
3. Palmar digital nerves and vessels for the medial 3 fingers.

N.B.: Pus in these spaces may spread **proximally** deep to the flexor retinaculum to enter the forearm in front of the pronator quadratus, or spread **distally** into the subcutaneous tissue of the webs of the fingers (between the roots of the fingers).

SYNOVIAL SHEATHS



A. Synovial sheaths of flexor tendons:

• In the palm:

1. A large sheath envelops the tendons of the flexor digitorum superficialis and profundus together and is called the common flexor sheath (or ulnar bursa).

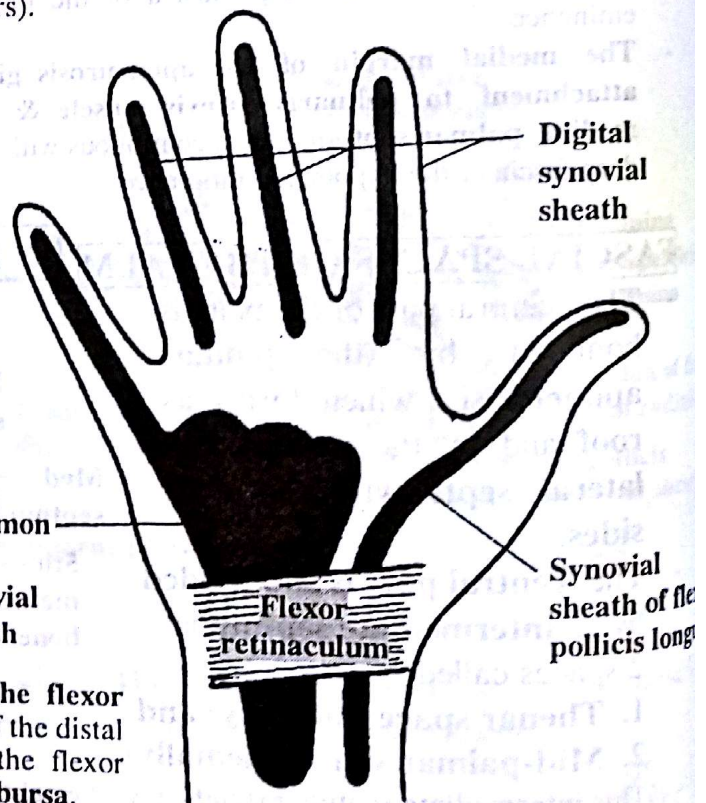
- It extends **proximally** into the forearm through the carpal tunnel to about 2 cm above the flexor retinaculum.

- **Distally**, it reaches the center of the palm and is prolonged on the tendons of the little finger as far as the base of its distal phalanx (does not surround the tendons of the other fingers).

2. A separate sheath envelops the tendon of the flexor pollicis longus extending on it from the base of the distal phalanx of the thumb to about 2 cm above the flexor retinaculum. Its part in the palm is called **radial bursa**.

• In the fingers:

The tendons of the **index, middle and ring fingers** are enveloped each by a synovial sheath which extends from the base of the distal phalanx to the level of the head of the metacarpal bone where it ends blindly.



Digital synovial sheath

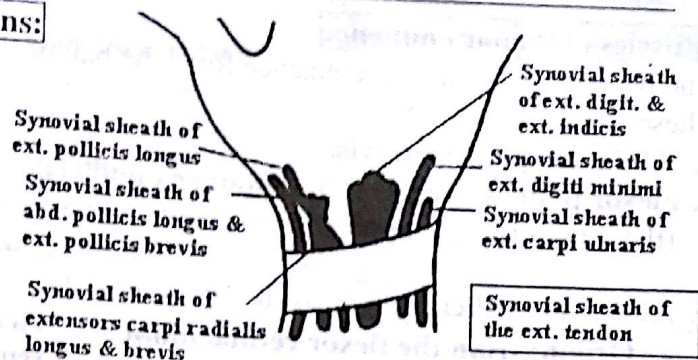
Common flex. synovial sheath

Flexor retinaculum

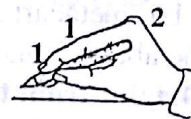
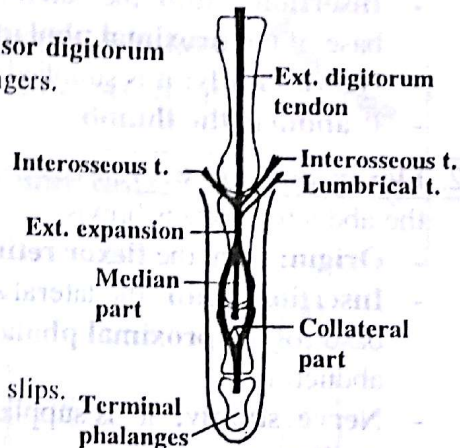
Synovial sheath of flex. pollicis longus

B. Synovial sheaths of extensor tendons:

- Synovial sheaths envelop the extensor tendons as they pass deep to the extensor retinaculum.
- They extend from about 2 cm above the extensor retinaculum to about 2 cm below it.

**Remember that about extensor expansion:**

- The extensor expansion is formed by the tendon of the extensor digitorum on the dorsum of the proximal phalanx of each the medial four fingers.
- The extensor expansion of each of the index, middle and ring fingers is joined by the tendons of one lumbrical and two interossei muscles.
- In addition, the extensor expansion of the index finger is joined by the tendon of the extensor indicis.
- The extensor expansion of the little finger is joined by the tendons of one lumbrical and only one interosseous muscles.
- In addition, it is joined by the tendon of extensor digiti minimi.
- The expansion divides into three slips, a middle and two collateral slips.
- The middle slips is inserted into the base of the middle phalanx.
- The two collateral slips fuse together to be inserted into the base of the terminal phalanx.
- By this arrangement, the extensor expansion can extend all the joints of the finger.
- However, the lumbricals and interossei extend the inter-phalangeal joints(1) through the expansion; but they flex the metacarpo-phalangeal joints(2).
- By this very important action the lumbricals and interossei put the hand into the writing position.

**Muscles of the hand**

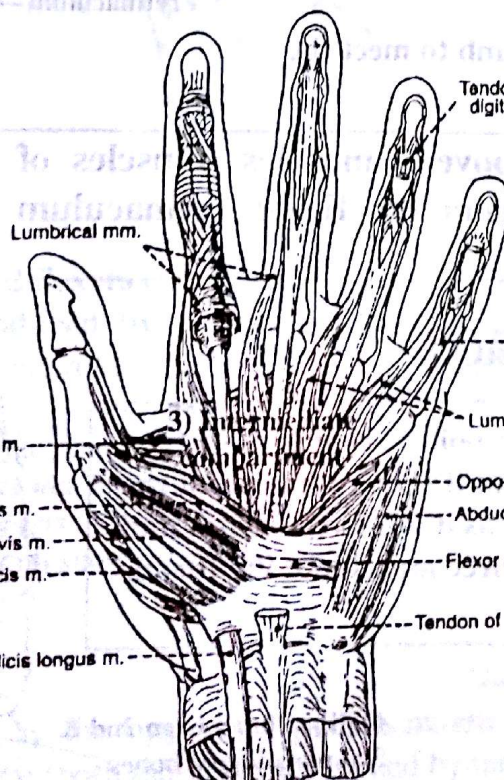
The intrinsic muscles of the hand (not including the long flexor tendons) are divided into 3 groups:

1. Muscles of the thenar eminence.
2. Muscles of the hypothenar eminence.
3. Muscles in the intermediate compartment: include the interossei and lumbricals.

1) Muscles of thenar eminence

Adductor pollicis m.
Flexor pollicis brevis m.
Abductor pollicis brevis m.
Opponens pollicis m.

Tendon of flexor pollicis longus m.

**2) muscles of hypothenar eminence**

Opponens pollicis m.
Flexor pollicis brevis m.
Abductor pollicis brevis m.
Adductor pollicis m.

Muscles of thenar eminence

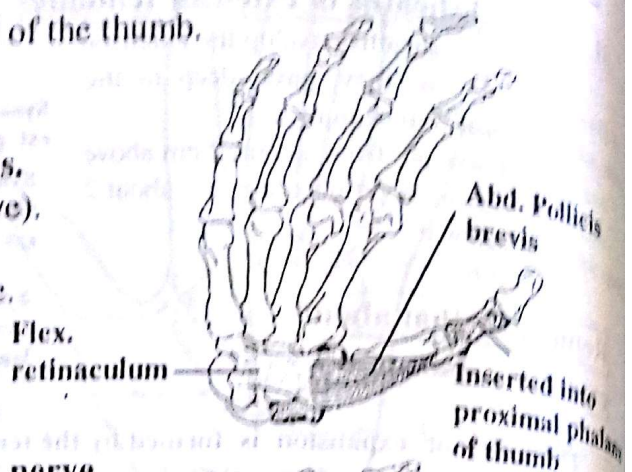
The muscles of the thenar eminence form the ball of the thumb.

These are the following:

1. **Abductor pollicis brevis.**
 2. **Flexor pollicis brevis.**
 3. **Opponens pollicis.**
- (the 3 muscles are supplied by the median nerve).

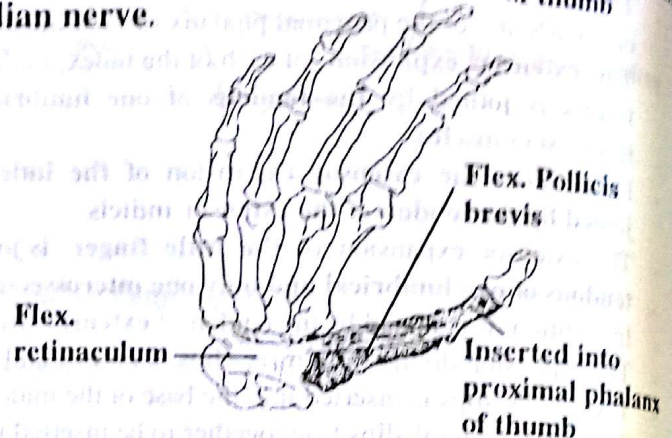
1. **Abductor pollicis brevis:** is the lateral muscle.

- **Origin:** from the flexor retinaculum
- **Insertion:** into the lateral side of the base of the proximal phalanx.
- **Nerve supply:** it is supplied by the median nerve.
- It abducts the thumb.



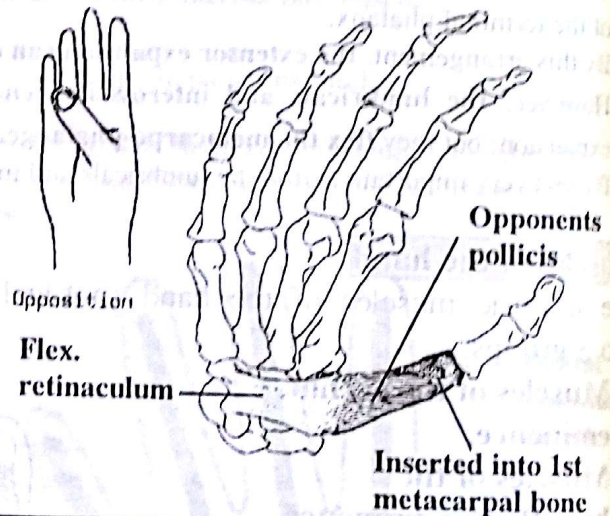
2. **Flexor pollicis brevis:** lies medial to the abductor pollicis brevis.

- **Origin:** from the flexor retinaculum.
- **Insertion:** into the lateral side of the base of the proximal phalanx (as the abductor).
- **Nerve supply:** it is supplied by the median nerve.
- It flexes the thumb.



3. **Opponens pollicis:** lies directly on the 1st metacarpal bone under cover of the above 2 muscles.

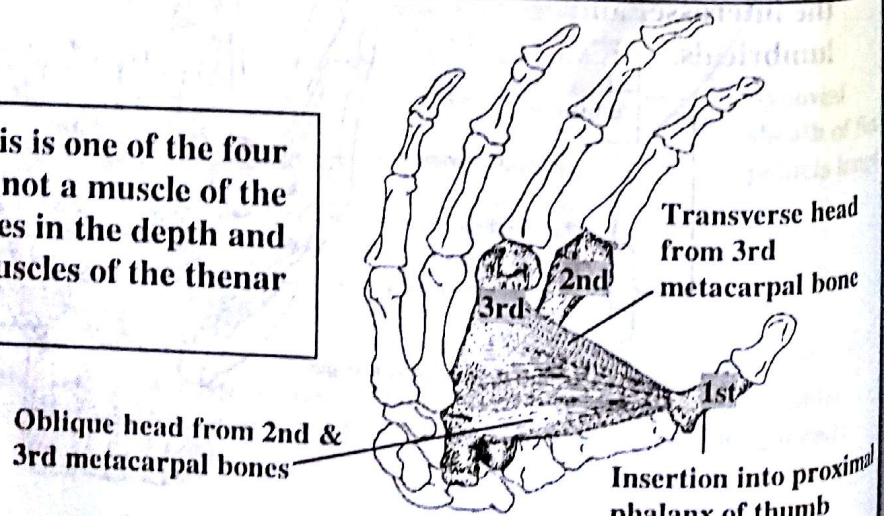
- **Origin:** from the flexor retinaculum.
- **Insertion:** into the shaft of the 1st metacarpal bone.
- **Nerve supply:** it is supplied by the median nerve.
- It opposes the thumb to meet the other fingers.



N. B.: All the above 3 muscles (muscles of thenar eminence) of the thumb arise from the flexor retinaculum and are supplied by the median nerve.

ADDUCTOR POLLICIS

N.B.: The adductor pollicis is one of the four *thenar muscles*, but it is not a muscle of the *thenar eminence* as it lies in the depth and medial to the three muscles of the thenar eminence.



(Adductor pollicis muscle continued)

- **Origin:** it arises by 2 heads (**oblique and transverse**).
The **oblique head** arises from the bases of the 2nd and 3rd metacarpal bones. While the **transverse head** arises from the front of the shaft of the 3rd metacarpal bone.
- **Insertion:** the 2 heads unite and are inserted together into the **medial side of the base of the proximal phalanx of the thumb**.
- **Nerve supply:** it is supplied by the **deep branch of the ulnar nerve**.
- **Action:** it **adducts the thumb**.

Remember that:

- (1) The **radial artery** enters the hand between the 2 heads of the **adductor pollicis muscle** and continue as **deep palmar arch**.
- (2) The **adductor pollicis muscle** is the only **thenar muscle** supplied by the **ulnar nerve**.

**MOVEMENTS OF THE THUMB****1. Adduction and abduction:**

- Occur in a plane at right angle to the plane of the palm (vertical to the palm).
- In abduction the thumb moves away from the palm and in adduction it is drawn towards the palm.
- **Adduction is produced by the adductor pollicis only** (ulnar nerve).
- While **abduction is produced by both abductors** (longus which is supplied by the posterior interosseous nerve and brevis which is supplied by the median nerve).



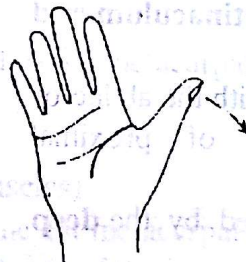
Abduction



Adduction

2. Flexion and extension:

- Occur parallel to the plane of the palm (horizontal plane).
- In flexion the thumb moves medially towards the little finger in front of and parallel to the palm. while in extension the reverse occurs.
- **Flexion is produced by 2 flexors** (longus and brevis which are supplied by the median).
- While **extension is produced by 2 extensors** (longus and brevis which are supplied by the posterior interosseous).



Extension



Flexion

3. Opposition:

- It is the movement by which the palmar surface of the tip of the thumb comes in contact with the palmar surface of the tip of any of the other 4 fingers.
- In this movement the thumb shows a combination of 2 movements:
 1. **Flexion.**
 2. **Medial rotation.**
- Opposition is produced by the **opponens pollicis** muscle and is assisted by the **flexor pollicis brevis** muscle (both muscles are supplied by the median nerve).



Opposition

- The opposition movement of opposition occurs at 2 joints:
 1. Carpo-metacarpal joint of the thumb: it is a synovial joint "saddle-type" (concave, convex). Between the base of the 1st metacarpal bone and the trapezium. It allows adduction, abduction, flexion, extension and some rotation.
 2. Metacarpo-phalangeal joint: here, the flexor pollicis brevis produces flexion and medial rotation of the proximal phalanx of the thumb (thus cooperating with the opponens).

MUSCLES OF THE HYPOTHENAR EMINENCE

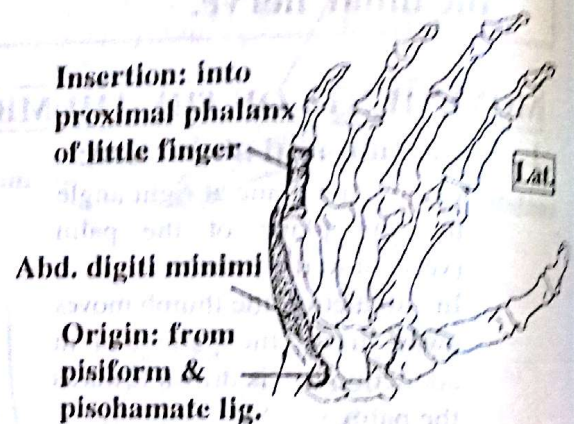
These are the following:

1. **Abductor digiti minimi**: medially.
2. **Flexor digiti minimi**: laterally.
3. **Opponens digiti minimi**: deep to the above 2 muscles.
4. **Palmaris brevis**: lies beneath the skin of the eminence and is inserted into the skin on the medial side of the hand.

All these 4 muscles are supplied by the ulnar nerve.

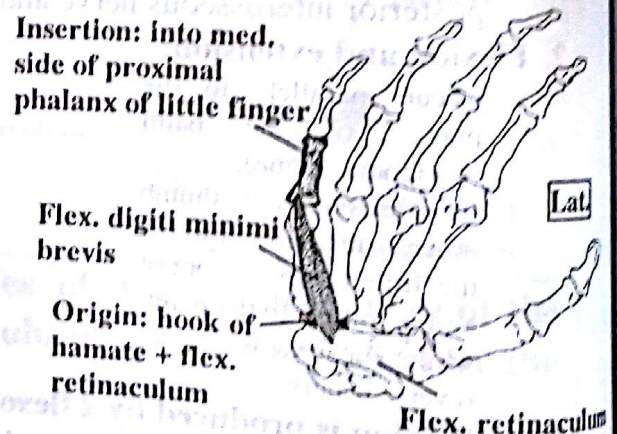
1. Abductor digiti minimi: medial to the flexor digiti minimi brevis.

- It takes origin from the **pisiform** and **pisohamate ligament**.
- It is inserted into the **medial side of the base of the proximal phalanx of little finger**.
- It is supplied by the deep branch of ulnar nerve.
- It abducts the little finger.



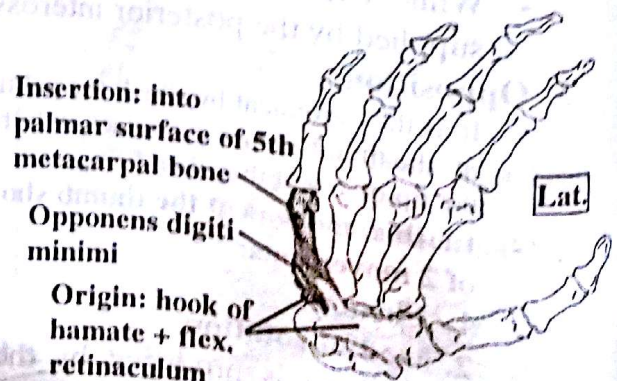
2. Flexor digiti minimi brevis: lateral to the abductor digiti minimi.

- **Origin**: from the **flexor retinaculum** and **hook of hamate**.
- **Insertion**: it is inserted with the abductor digiti minimi into base of proximal phalanges of little finger.
- **Nerve supply**: it is supplied by the **deep branch of ulnar nerve**.
- It **flexes the metacarpo-phalangeal joint** of the little finger.

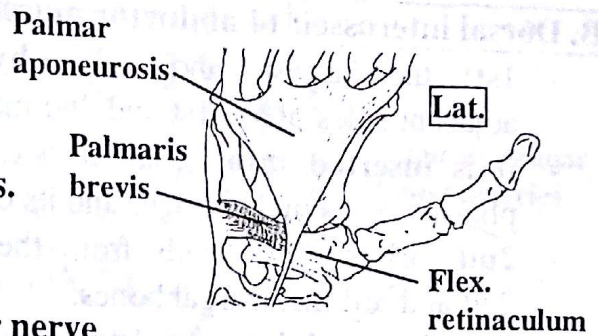


3. Opponens digiti minimi: deep to the abductor and flexor brevis.

- **Origin**: from the **hook of hamate** and **flexor retinaculum**.
- **Insertion**: it is inserted into the medial half of the palmar surface of the fifth metacarpal bone.
- **Nerve supply**: it is supplied by deep branch of ulnar nerve.

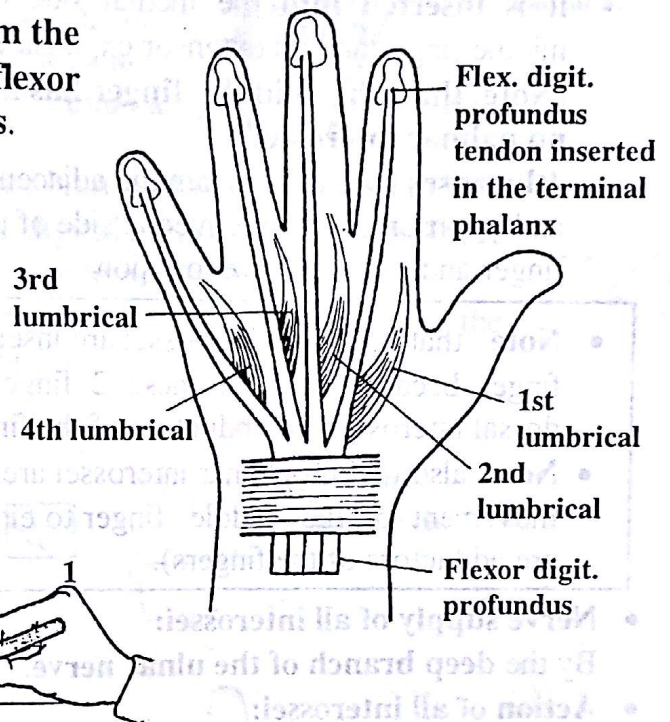


- 4. Palmaris brevis:** This is a small sheet of muscle in the superficial fascia of the hypothenar eminence.
- **Origin:** flexor retinaculum, palmar aponeurosis.
 - **Insertion:** skin of the palm.
 - **Action:** Corrugates skin of palm.
 - It is supplied by the superficial branch of ulnar nerve.



Lumbrical muscles

- These are 4 slender muscles which arise from the lateral side of the tendons of the flexor digitorum profundus to the medial 4 fingers.
- Each tendon is inserted into the lateral margin of the extensor expansion of the corresponding finger.
- The lateral 2 muscles (1st & 2nd) are supplied by the median nerve.
- While the medial 2 muscles (3rd & 4th) are supplied by the ulnar nerve.
- They act in association with the interosseous muscles (through the extensor expansion) to flex the metacarpo-phalangeal(1) and extend the inter phalangeal joints(2), i.e. put the hand in the "writing position".

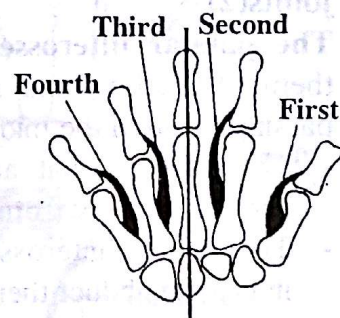


Interosseous muscles

These muscles are directly related to the metacarpal bones and are divided into 2 groups: A) palmar and B) dorsal.

A. Palmar interossei: (4 adductor muscles)

- **1st:** arises from the base of the 1st metacarpal bone and is inserted into the medial side of the base of the proximal phalanx of the thumb (may be absent).
- **2nd:** arises from the whole length of the 2nd metacarpal bone and is inserted into the medial border of the extensor expansion (dorsal digital expansion) of the index finger.
- **3rd:** arises from the whole length of the 4th metacarpal bone (not the 3rd) and is inserted into the lateral border of the extensor expansion of the ring finger.
- **4th:** arises from the whole length of the 5th metacarpal bone and is inserted into the lateral margin of the extensor expansion of the little finger.

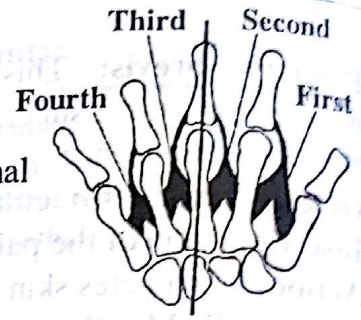


N.B.: The 2nd, 3rd and 4th palmar interossei are inserted like the lumbricals into the extensor expansion. In contrast, each of the dorsal interossei is inserted into both the extensor expansion and the base of the proximal phalanx.

Upper Limb

B. Dorsal interossei: (4 abductor muscles)

- **1st:** the largest, and arises by 2 heads from the adjacent sides of the 1st and 2nd metacarpal bones.
- It is **inserted into** the lateral side of the base of the proximal phalanx of the index finger and its extensor expansion.
- **2nd:** arises by 2 heads from the adjacent sides of the 2nd and 3rd metacarpal bones.
- It is **inserted into** the lateral side of the base of the proximal phalanx of the middle finger and its extensor expansion.
- **3rd:** arises by 2 heads from the adjacent sides of the 3rd and 4th metacarpal bones.
- It is **inserted into** the medial side of the base of the proximal phalanx of the middle finger and its extensor expansion.
- (Note that the middle finger has 2 dorsal interossei inserted into it but has no palmar interossei).
- **4th:** arises by 2 heads from the adjacent sides of the 4th and 5th metacarpal bones and is inserted into the medial side of the base of the proximal phalanx of the ring finger and its extensor expansion.



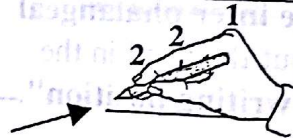
- **Note** that no dorsal interossei are inserted into the thumb or the little finger because each of these 2 fingers has its own abductor (the dorsal interossei are abductors of the fingers).
- **Note** also that no palmar interossei are inserted into the middle finger because the movement of the middle finger to either side is abduction (the palmar interossei are adductors of the fingers).



- **Nerve supply of all interossei:**
By the deep branch of the ulnar nerve.

- **Action of all interossei:**

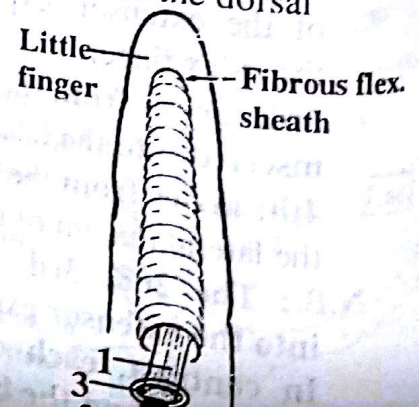
1. All interossei put: the hand in the "writing positions" which means flexing the metacarpophalangeal joints(1) and extending the inter-phalangeal joints(2) of the fingers. Paralysis of this action leads to a deformity called "claw-hand" where there are extension of metacarpophalangeal joints(1) and flexion of inter-phalangeal joints(2).



2. The palmar interossei adduct the fingers, while the dorsal interossei abduct them. Adduction and abduction of the fingers take place in relation to an axis passing through the midline of the middle finger.
 - This means that any side movement of the middle finger is regarded as abduction away from the axis.
 - The palmar interossei adduct the fingers towards this axis, while the dorsal interossei abduct them away from it.

**FIBROUS FLEXOR SHEATHS**

- These are sheaths of deep fascia that partially surround the long flexor tendons (flexor digitorum superficialis(1) and profundus(2)) in their course in the digits.
- These sheaths form together with the bones of the phalanges tunnels for the tendons called osteo-fascial canals which are lined with synovial sheaths(3).



ULNAR ARTERY IN THE PALM

The ulnar artery enters the palm by passing **superficial** (anterior) to the **flexor retinaculum**.

It gives a **deep branch** which dips in between the **hypothenar muscles** (the **abductor digiti minimi** and the **flexor digiti minimi brevis**; and then through the **opponens digiti minimi**) to **anastomose with the medial end of the deep palmar arch** (this arch is formed mainly by the radial artery).

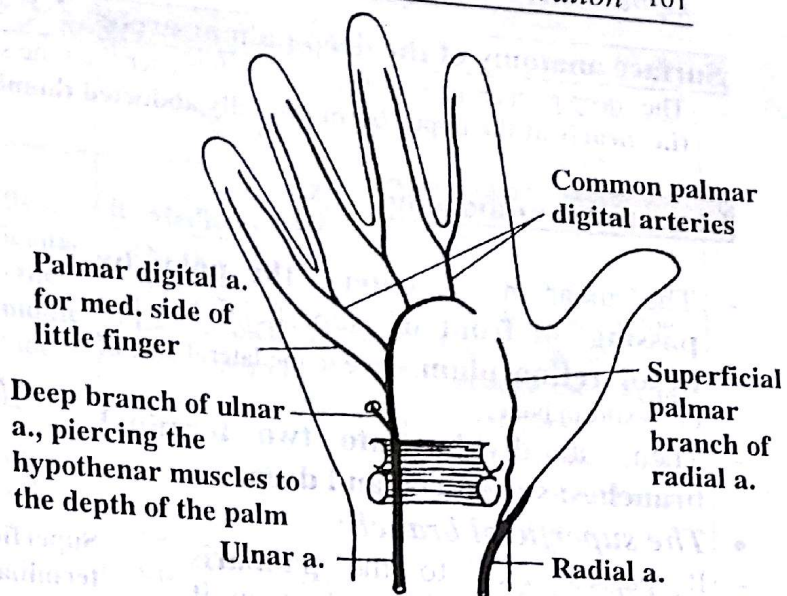
Then, the **ulnar artery continues as the superficial palmar arch**.

The arch may be completed by the **superficial palmar branch of the radial artery (30%)**.

The **superficial palmar arch** gives a: i) **palmar digital artery to the medial side of the little finger**. Then, it gives ii) **three common palmar digital arteries**.

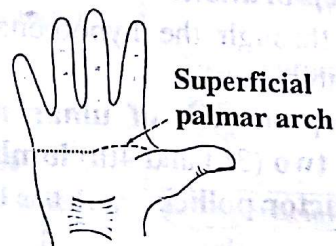
The **common palmar digital arteries** divide into **palmar digital arteries** for the adjacent sides of the little, ring, middle and index fingers.

Thus, the arch gives **palmar digital arteries to the medial 3 and half fingers**.



Surface anatomy of the superficial palmar arch:

The **superficial palmar arch** lies nearly at the level of the **distal border of the fully abducted thumb**.



Radial artery in the hand

The **radial artery** reaches the palm from **dorsum of the hand** by **passing between the two heads of the first dorsal interosseous**.

Then, it passes **between the two heads of the adductor pollicis**.

Then the **radial artery continues laterally as the deep palmar arch**.

The arch lies on the **carpus deep to the flexor tendons**.

The arch is usually completed by **anastomosing with the deep branch of the ulnar artery**.

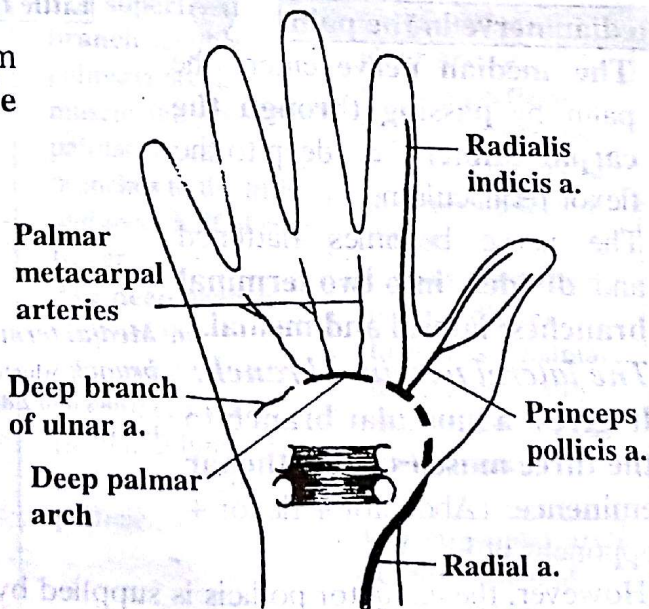
When it reaches the palm, the **radial artery gives two branches**:

1. **Princeps pollicis artery**: which divides into two **palmar digital branches** to the thumb.
2. **Radialis indicis artery**: for the **radial side of the index finger**.

Thus, the **radial artery gives palmar digital arteries to the lateral one and half fingers**.

The **deep palmar arch (which is the continuation of the radial artery in the hand)** gives:

- a. **Three palmar metacarpal arteries** which join the three **common palmar digital arteries** of the **superficial palmar arch**.
- b. It also gives **three perforating arteries** which pierce the **interossei muscles** to **anastomose with the dorsal metacarpal arteries**.



Surface anatomy of the deep palmar arch:

- The deep palmar arch is about one inch higher than the superficial palmar arch (i.e. nearly at the upper border of fully abducted thumb).



Deep palmar arch



Ulnar nerve in the palm



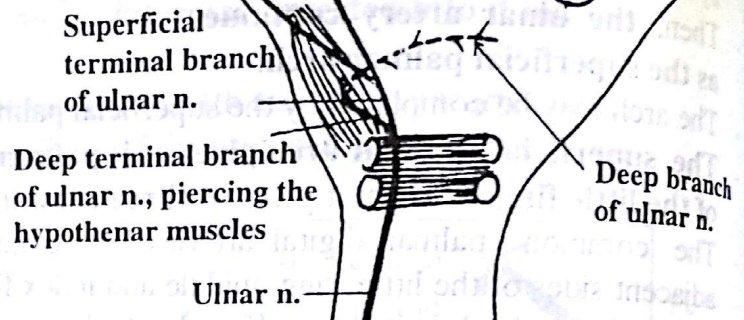
- The ulnar nerve enters the palm by passing in front of (superficial to) the flexor retinaculum, close to the lateral side of the pisiform bone.
- Then, it divides into two terminal branches: superficial and deep.

• The superficial branch:

- It passes deep to the palmaris brevis, supplies it, and then it divides into two palmar digital branches: one for the medial side of the little finger; and the other for the adjacent sides of the little and ring fingers.

• The deep branch:

- It dips through the hypothenar muscles and then runs in the concavity of the deep palmar arch.
- The deep branch of ulnar nerve supplies: the three hypothenar muscles, the medial two (3rd and 4th) lumbrical muscles, all palmar and dorsal interossei and the adductor pollicis.



Median nerve in the palm



- The median nerve enters the palm by passing through the carpal tunnel, i.e. deep to the flexor retinaculum.

- The nerve becomes flattened and divides into two terminal branches: lateral and medial.

• The lateral terminal branch:

- It gives a muscular branch to the three muscles of the thenar eminence. (Abductor + flexor + opponens pollicis).

- (However, the adductor pollicis is supplied by deep branch of ulnar nerve).

- Then, the lateral terminal branch divides into three palmar digital branches: two for the thumb and one for the radial side of the index finger.

- The latter gives a branch to the first lumbrical muscle.

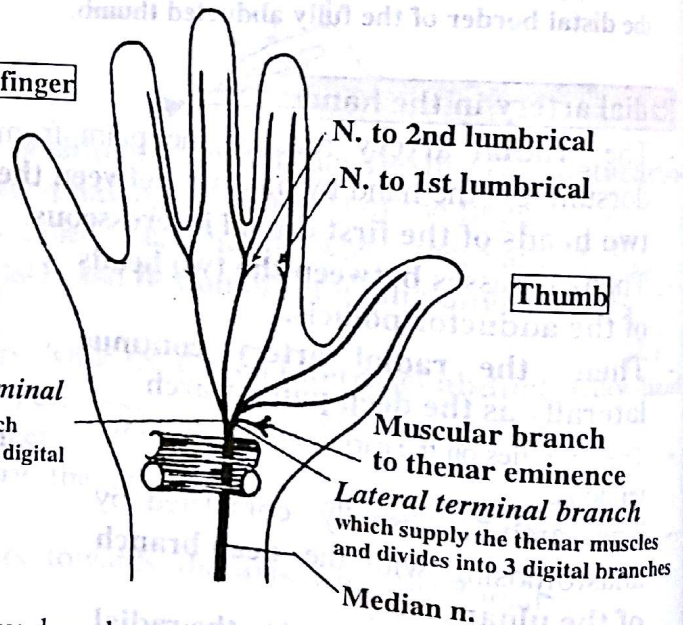
• The medial terminal branch:

- It divides into two palmar digital branches: the first one divides to supply the adjacent sides of the index and middle fingers; and during its course it gives a branch to the second lumbrical muscle.

- The other branch divides to supply the adjacent sides of the middle and ring fingers.

Little finger

Medial terminal branch which divides into 2 digital branches



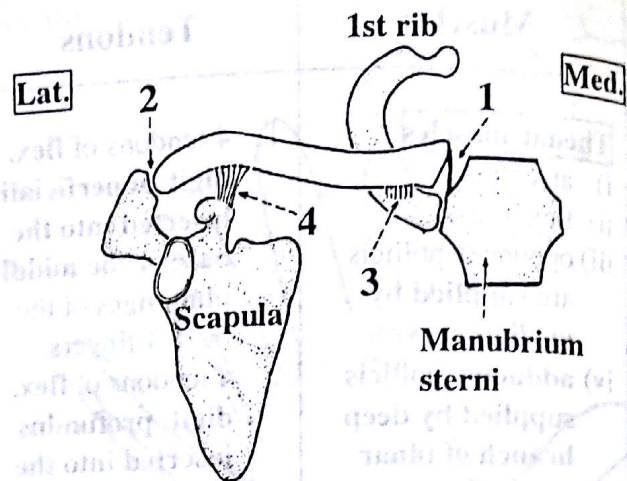
Thumb

Summary of the palm of the hand

Muscles	Tendons	Nerves	Arteries
Thenar muscles i) abductor ii) flexor, and iii) opponens pollicis are supplied by median nerve + iv) adductor pollicis supplied by deep branch of ulnar nerve.	1. 4 tendons of flex. digit. superficialis inserted into the base of the middle phalanges of the med. 4 fingers. 2. 4 tendons of flex. digit. profundus inserted into the terminal phalanges of the med. 4 fingers.	1. Median nerve - Divides into 2 branches: - Lat. branch supplies thenar muscles except the adductor pollicis. - Gives 3 palmar digital branches for the thumb and lat. side of index finger + 1st lumbrical. - Med. branch gives 2 palmar digital branches to the adjacent sides of index & middle and middle & ring fingers + branch to the 2nd lumbrical. 2. Ulnar nerve - Divides into superficial and deep branches. - The superficial branch supplies palmaris brevis muscle and gives 2 palmar digital branches to the little and med. half of ring finger. - The deep branch supplies the hypotenar muscles + all interossei + medial 2 lumbricals and the adductor pollicis.	1. Radial artery - Reaches the palm from the back of the hand by passing between the 2 heads of 1st dorsal interosseous m. and 2 heads of adductor pollicis m. - Gives: i) Princeps pollicis. ii) Radial indices. iii) Then continue as deep palmar arch. 2. Ulnar artery - Gives deep branch joins the deep palmar arch. - Then continue as superficial palmar arch. 3. Superficial palmar arch - Continuation of ulnar artery. - It lies superficial to the flexor tendons at the distal border of the fully abducted thumb. - It gives: 3 common palmar digital branches + palmar digital branch to the medial side of little finger. 4. Deep palmar arch - Continuation of radial artery. - It lies deep to the flexor tendons at the upper border of the fully abducted thumb. - It gives: 3 palmar metacarpal arteries + 3 perforating arteries.
Hypothenar muscles i) abductor ii) flexor, and iii) opponens digiti minimi + palmaris brevis all are supplied by ulnar nerve.			
Lumbricals - 4 muscles arise from lat. side of flex. digitorum profundus tendon and inserted into ext. expansion of med. 4 fingers. - The lat. 2 supplied by median nerve. - The med. 2 supplied by ulnar nerve. - Action writing position.			
Interossei - 4 dorsal abductors & 4 palmar adductors to the fingers. - All joints the ext. expansion of the med. 4 fingers. - All help in writing position. - All supplied by deep branch of ulnar nerve.			

JOINTS RELATED TO THE CLAVICLE

- The clavicle articulates medially with the sternum at the **sterno clavicular joint(1)**, and laterally with the acromion at the **acromio clavicular joint(2)**.
- Its medial end is supported by the **costo-clavicular ligament(3)**.
- Its lateral end is supported by the **coraco-clavicular ligament(4)**.

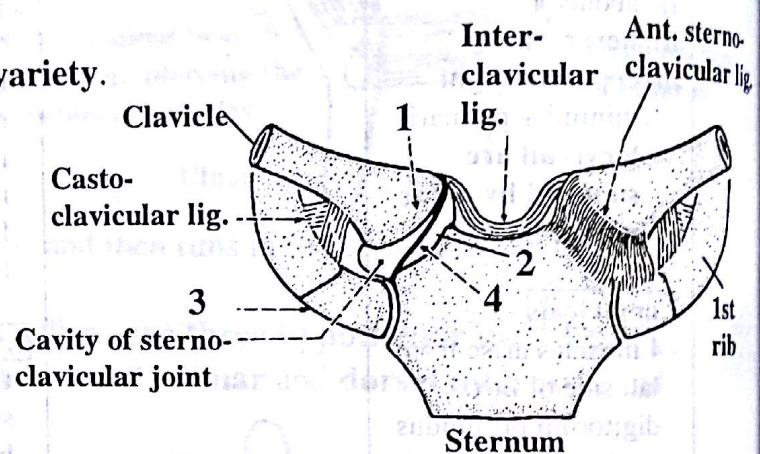
**A. Sterno-clavicular joint:**• **Type and articulating bones:**

- It is a synovial joint of double plane variety.
- It lies between:

- Medial end of the clavicle(1).
- Clavicular notch of the manubrium sterni(2) and the costal cartilage of the 1st rib(3).
- The joint cavity is divided completely into 2 separate cavities by an articular disc(4).

For this reason this joint may be classified as **complex joint**.

- This articular disc is attached above to the upper part of the medial end of the clavicle and below to the junction between the clavicular notch of the sternum and the 1st costal cartilage.

• **Ligaments:**

1. **Anterior and posterior sterno-clavicular ligaments:** thickened parts of the fibrous capsule.
2. **Costo-clavicular ligament:** this is a strong ligament extending between the medial part of the under surface of the clavicle and the end of the 1st rib.
3. **Inter-clavicular ligament:** between the medial ends of the 2 clavicles.

• **Movements:**

This joint is an articulation between the **sternum** (fixed) and the **clavicle** (movable) so the moment at this joint is represented by the movement of the clavicle in different directions such as:

1. **Forward movement of the clavicle** > by the serratus anterior muscle.
2. **Backward movement of the clavicle** > by trapezius and rhomboid muscle.
3. **Elevation of the clavicle** > by trapezius, sterno mastoid, levator scapula & rhomboid muscle.
4. **Depression of the clavicle** > pectoralis minor & subclavius muscles.

N.B.:

1. This joint is the only bony articulation between the upper limb and the axial skeleton through which the weight of the upper limb is transmitted to the axial skeleton.
2. The clavicle is a part of the shoulder girdle and thus the sterno clavicular joint moves with the movements of the scapula.

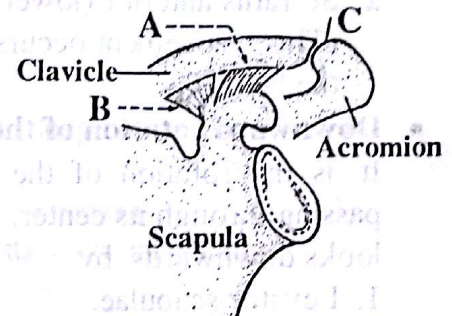
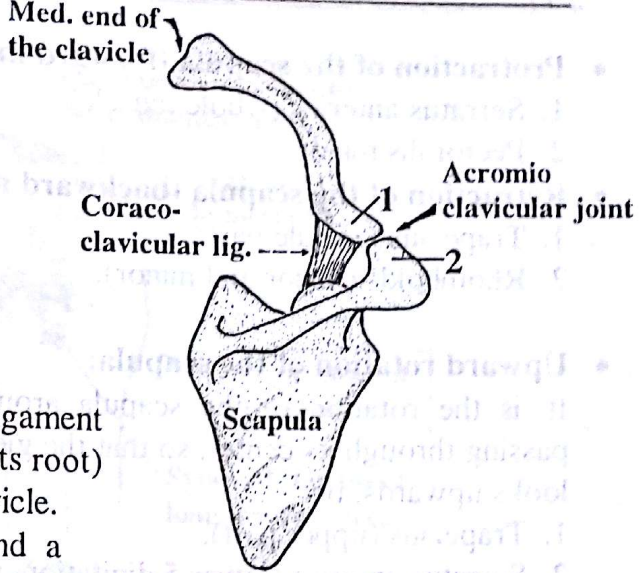
B. Acromio-clavicular joint:

• Type and articulating bones:

- It is a synovial joint of the plane variety.
- It lies between:
 - Acromial end of the clavicle(1).
 - Medial margin of the acromion(2).

• Ligaments:

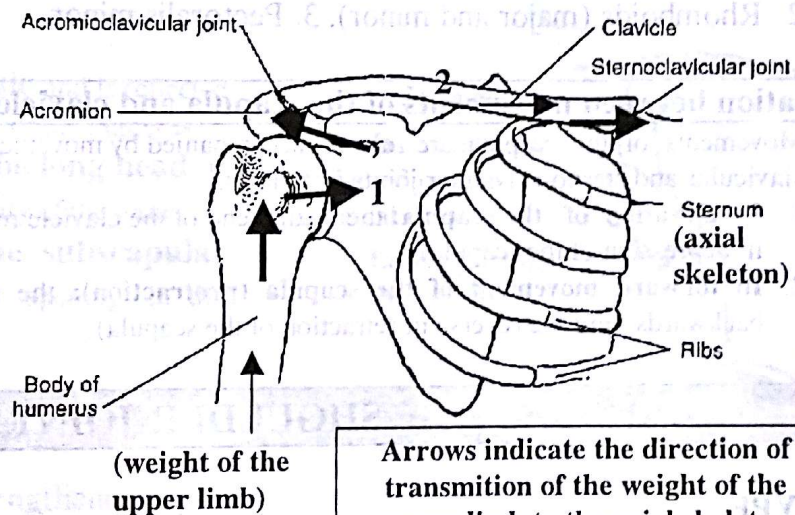
1. **Coraco-clavicular ligament:** a strong ligament extending between the coracoid process (at its root) and under surface of the lateral end of the clavicle.
 - It is formed of a **trapezoid part(A)** and a **conoid part(B)**.
 - This is very important ligament which transmits the weight of upper limb from the scapula to the clavicle > to the axial skeleton.
 - Fractures of the clavicle medial to this ligament lead to falling of the upper limb.
2. **Acromio-clavicular ligament(C):** covers the upper surface of the joint.



SHOULDER GIRDLE



- The shoulder girdle consists of the **scapula (1)** posterior and **clavicle (2)** anterior.
- The 2 bones articulating together at the acromio-clavicular joint.
- By this girdle the weight of upper limb is transmitted to the axial skeleton.



MOVEMENTS OF THE SHOULDER GIRDLE:

- The shoulder girdle moves at 2 joints (the sterno clavicular & acromio clavicular) at the same time.

The main movements of the girdle are carried by the scapula as follows:

• Elevation of the scapula:

The whole upper border rises with **no rotation**.

This is produced by:

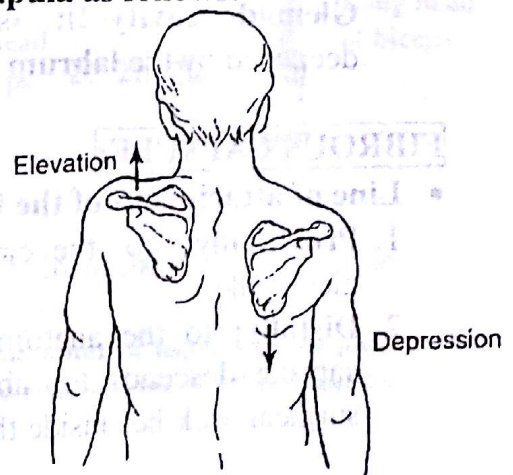
1. Upper part of trapezius.
 2. Levator scapulae.
- Note that the 2 muscles oppose each other as regards the movement of rotation of the scapula.

• Depression of the scapula:

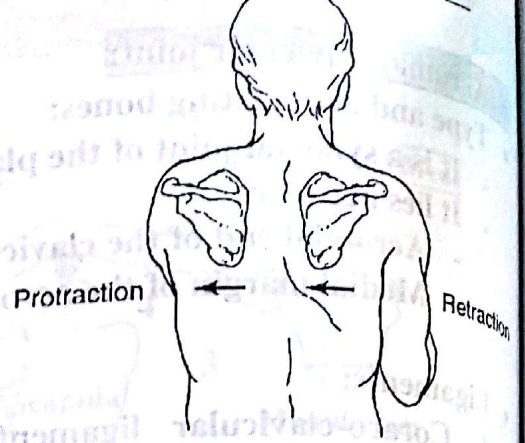
The whole scapula descends to a lower level.

This is produced by:

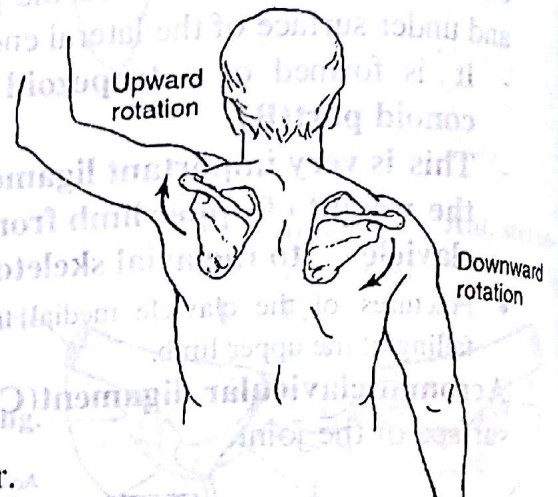
1. Pectoralis minor.
2. Serratus anterior (lower part).
3. Trapezius (lower fibers).



- **Protraction of the scapula (forward movement):** by
 1. Serratus anterior (whole muscle).
 2. Pectoralis minor.
- **Retraction of the scapula (backward movement):** by
 1. Trapezius (middle part).
 2. Rhomboids (major and minor).



- **Upward rotation of the scapula:**
It is the rotation of the scapula around an axis passing through its center, so that the glenoid cavity looks upwards, by:
 1. Trapezius (upper part).
 2. Serratus anterior (lower 5 digitations).
 (This movement occurs in raising the arm above the head).



- **Downward rotation of the scapula:**
It is the rotation of the scapula around an axis passing through its center, so that the glenoid cavity looks downwards, by:
 1. Levator scapulae.
 2. Rhomboids (major and minor).
 3. Pectoralis minor.

Relation between movements of the scapula and clavicle

- Movements of the scapula are always accompanied by movements of the clavicle at the acromio-clavicular and sterno-clavicular joints as follows.
 1. **In elevation of the scapula:** the medial end of the clavicle moves downwards (and the reverse in depression of the scapula).
 2. **In forward movement of the scapula (protraction):** the medial end of the clavicle moves backwards (and the reverse in retraction of the scapula).



SHOULDER JOINT

TYPE:

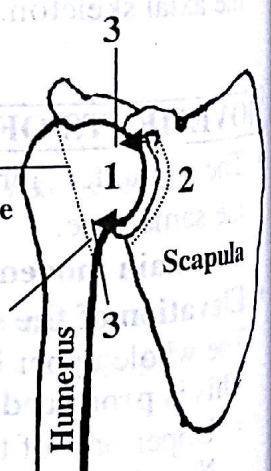
It is a synovial joint of the "ball and socket" variety.

ARTICULAR SURFACES:

- **Head of the humerus(1):** forms less than 1/2 of a sphere.
- **Glenoid cavity(2):** shallow, but is slightly deepened by the **labrum glenoidale(3)**.

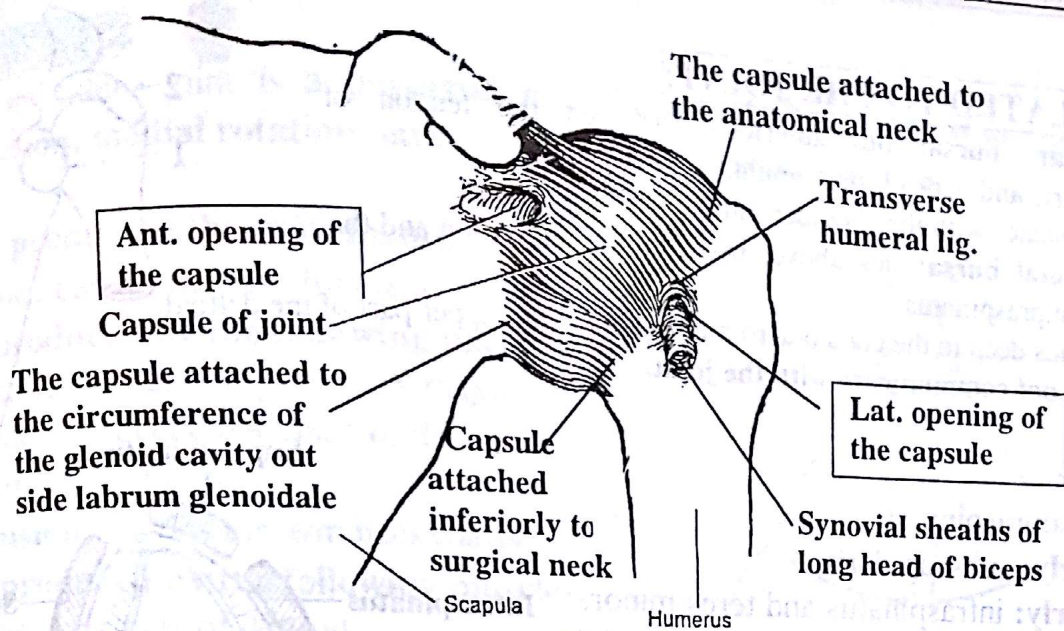
Attachment of the capsule to the anatomical neck

Inferiorly the capsule is attached to the surgical neck



FIBROUS CAPSULE:

- **Line of attachment of the fibrous capsule:**
 1. **Proximally:** to the circumference of the glenoid cavity outside the labrum glenoidale.
 2. **Distally:** to the anatomical neck of the humerus, except inferiorly where the capsule descends for about 1/2 inch on the surgical neck (thus, a part of the surgical neck lies inside the capsule).

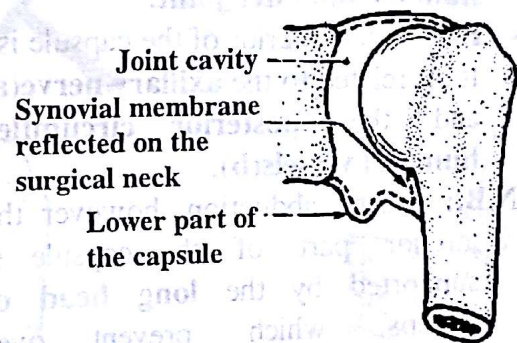


• Openings (apertures) in the capsule:

1. **Anterior opening:** through which the subscapular bursa (deep to the insertion of subscapularis) communicates with the cavity of the joint.
This gap occasionally allows for anterior dislocation of the head of the humerus.
2. **Lateral opening:** transmits the long head of biceps with its synovial sheath.

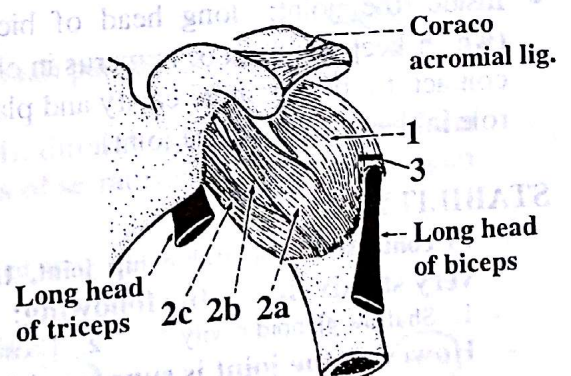
SYNOVIAL MEMBRANE:

1. It **lines the fibrous capsule** and is reflected downwards on the surgical neck of the humerus.
2. It **forms a sheath for the long head of biceps** which traverses the cavity of the joint.
3. It is **continuous with the subscapular bursa** through the anterior opening in the fibrous capsule.



LIGAMENTS:

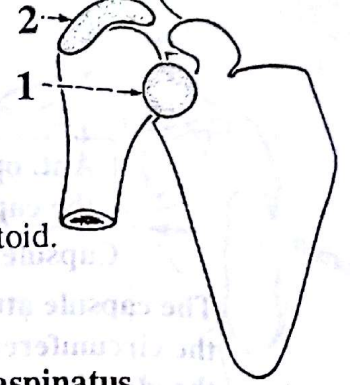
- The fibrous capsule is strengthened by the following ligaments:
1. **Coraco-humeral ligament(1):** extends from the root of the coracoid process to the greater tubercle of the humerus. It strengthens the upper part of the capsule.
 2. **Gleno-humeral ligaments:** these are 3 ligaments [superior(2a), middle(2b) and inferior(2c)] that extend from the upper and medial margins of the glenoid cavity to the lesser tubercle of the humerus (strengthens the front of the capsule).
 3. **Transverse humeral ligament(3):** extends transversely from the greater tubercle to the lesser tubercle bridging over the long head of biceps.



N.B.: Note that these ligaments mainly support the upper and anterior aspects of the joint leaving the lower aspect relatively unsupported with the risk of downward dislocation of the head of the humerus.

BURSAE RELATED TO THE JOINT:

1. **Subscapular bursa:** lies anteriorly, between the tendon of subscapularis and neck of the scapula. It communicates with the shoulder joint.
2. **Sub acromial bursa:** lies above, between the acromion and the tendon of supraspinatus.
 - It extends deep to the coraco-acromial ligament and upper part of the deltoid.
 - It does not communicate with the joint.

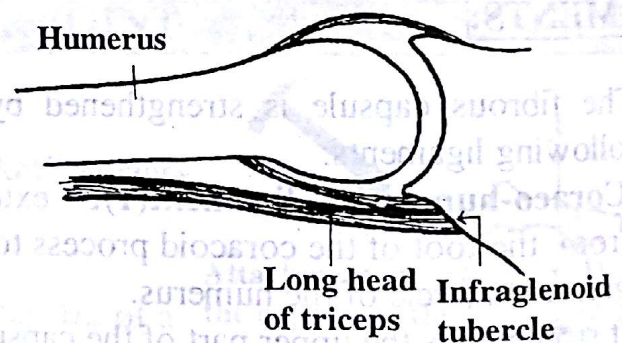
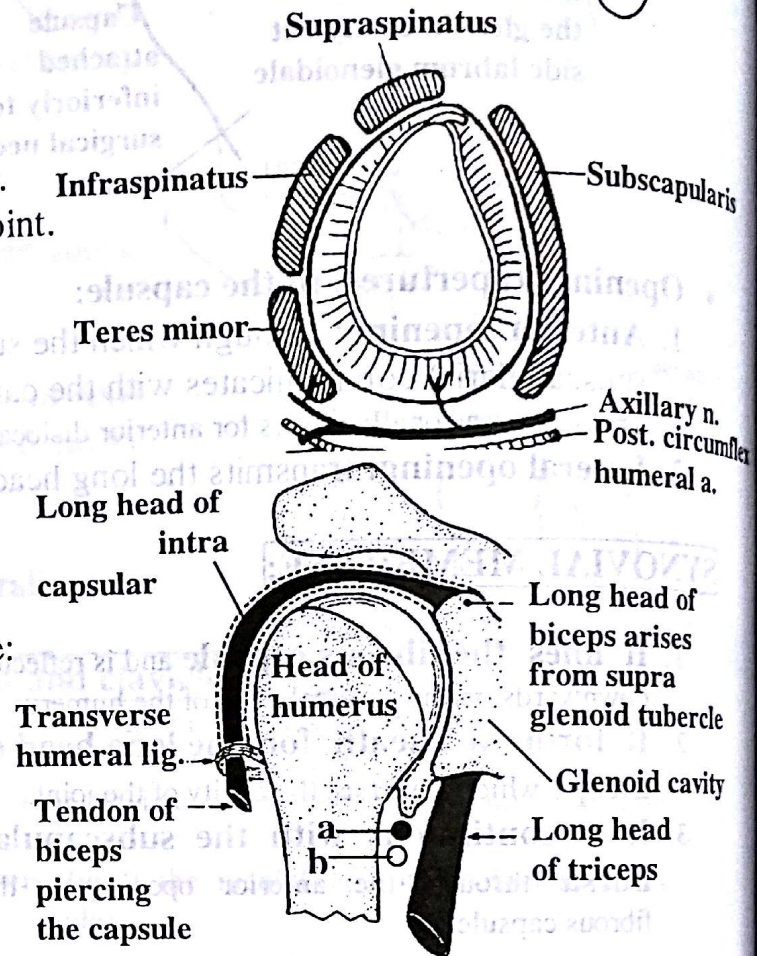


RELATIONS:

- **Above:** supraspinatus,
- **Anteriorly:** subscapularis,
- **Posteriorly:** infraspinatus and teres minor.
- The above muscles are very close to the joint.
- They are intimately adherent to the capsule forming what is called the **rotator cuff of the shoulder joint**.
- They are further covered by the deltoid muscle from in front, laterally and behind.
- They play an important role in the stability shoulder joint.
- **Below:** the inferior of the capsule is loose:
- It is related to the **axillary nerve(a)** and the **posterior circumflex humeral vessels(b)**.

N.B.: During abduction, however the inferior part of the capsule is supported by the **long head of triceps**, which prevent over abduction which leads to dislocation of the shoulder joint.

- Inside the joint: long head of biceps (which keep the head of humerus in close contact to the glenoid cavity and play a role in the stability of the joint).



STABILITY:

- In contrast to the stable hip joint, the shoulder joint is relatively weak and not very steady due to the following:
 1. Shallow glenoid cavity.
 2. Loose fibrous capsule.
 3. Weak ligaments.
- However, the joint is supported by the following:
 1. Surrounding scapular muscles which are inserted very close to the joint. subscapularis, supraspinatus, infraspinatus and teres minor (**the rotator cuff**).
 2. Coraco-acromial arch which supports the joint from above (formed by the coracoid process, acromion and coraco-acromial ligament).
- The lower part of the fibrous capsule is redundant with the arm adducted but becomes tense with the arm abducted up to 90° and more.
- This lower part of the capsule is supported by the long head of triceps.

MOVEMENTS:

The shoulder joint is a **polyaxial** joint having **flexion, extension, adduction, abduction, medial rotation, lateral rotation and circumduction**.

Muscles producing the movements:

- **Flexion:** carries the arm forwards and medially.

It is produced by the following muscles:

1. Clavicular head of pectoralis major.
2. Anterior (clavicular) part of deltoid.
3. Coracobrachialis.

- **Extension:** carries the arm backwards.

It is produced by the following muscles:

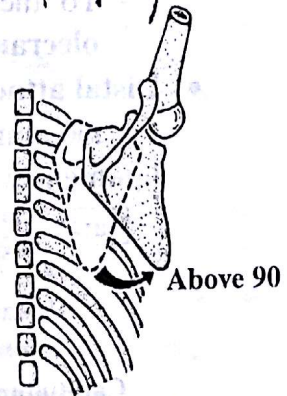
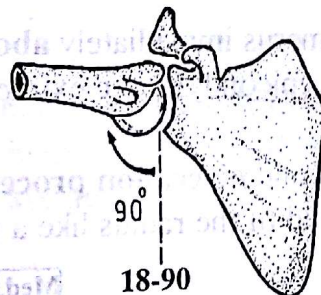
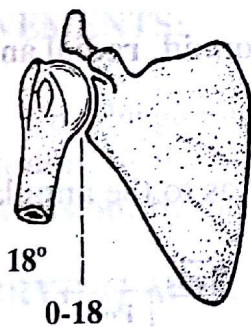
1. Posterior part of deltoid.
2. Latissimus dorsi.
3. Teres major.

- **Adduction:** by:

1. Latissimus dorsi.
2. Pectoralis major.
3. Teres major.

- **Abduction:** movement of the arm laterally and upwards.

It occurs in 3 stages: (abduction in degrees).



Muscles responsible for abduction:

1. **From 0° to 18°:** produced by supraspinatus.
2. **From 15° to 90°:** produced by middle (acromial) part of the deltoid.

The above 2 stages occur at shoulder joint.

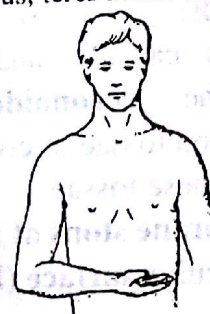
3. **Above 90°** (raising the arm above the head): through **upward rotation of the scapula** produced by the lower 5 digitations of serratus anterior and upper part of trapezius.

- To **protect the head of the humerus** from being displaced upwards during abduction, the muscles of the rotator cuff contract.

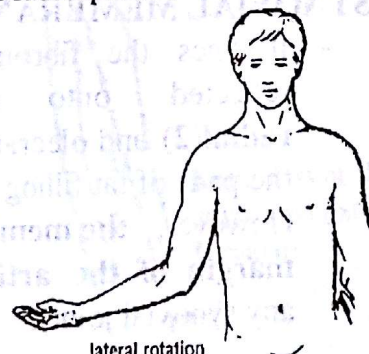
- These 4 muscles are the supraspinatus, infraspinatus, teres minor and subscapularis.
- They are inserted very close to the shoulder joint.

- **Medial rotation:** by:

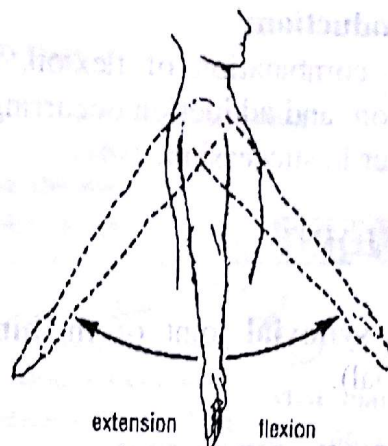
1. Pectoralis major.
2. Anterior part of deltoid.
3. Latissimus dorsi.
4. Teres major.
5. Subscapularis.



medial rotation

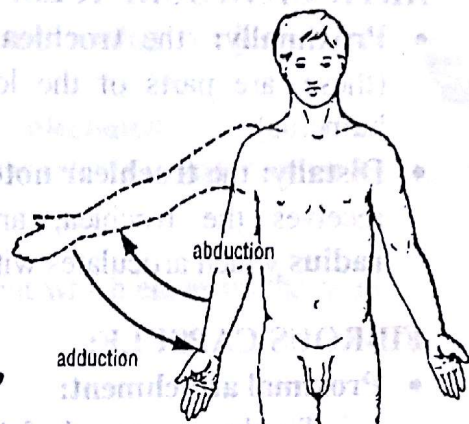


lateral rotation



extension

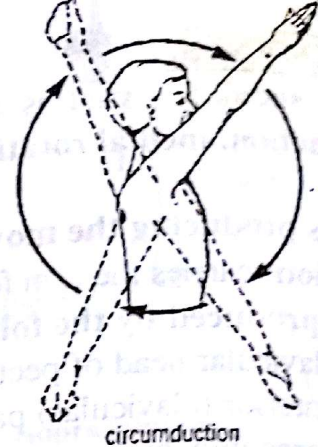
flexion



abduction

adduction

- **Lateral rotation:** by:
 1. Posterior part of deltoid.
 2. Infraspinatus.
 3. Teres minor.
- **Circumduction:**
Is the combination of flexion, abduction, extension and adduction occurring one after the other in succession.



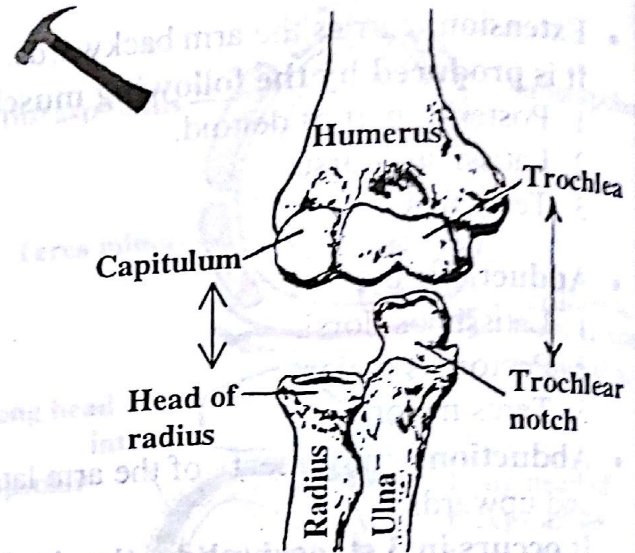
ELBOW JOINT

TYPE:

It is a **synovial joint** of the **hinge** variety (uni-axial).

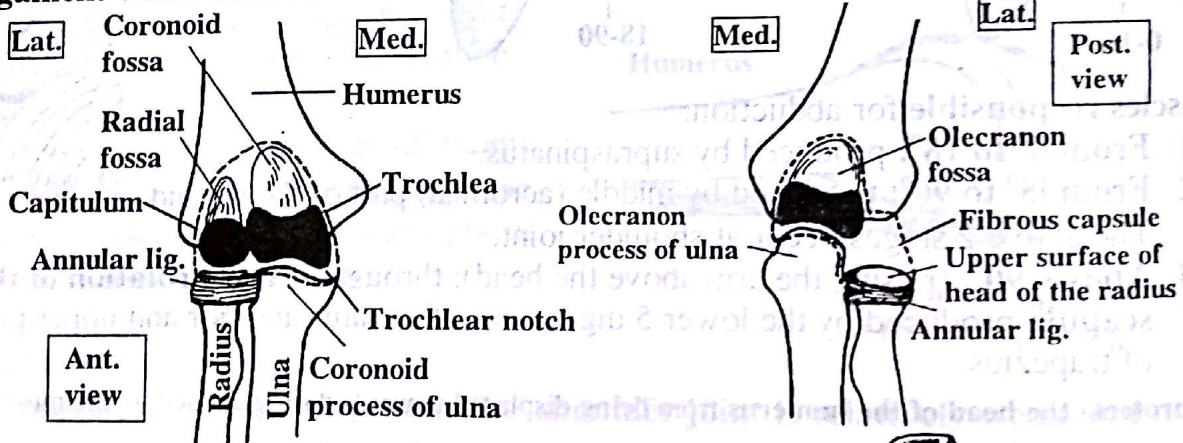
ARTICULAR SURFACES:

- **Proximally:** the **trochlea** and **capitulum** (these are parts of the lower end of the humerus).
- **Distally:** the **trochlear notch** of **ulna** which receives the trochlea, and the **head of radius** which articulates with the capitulum.



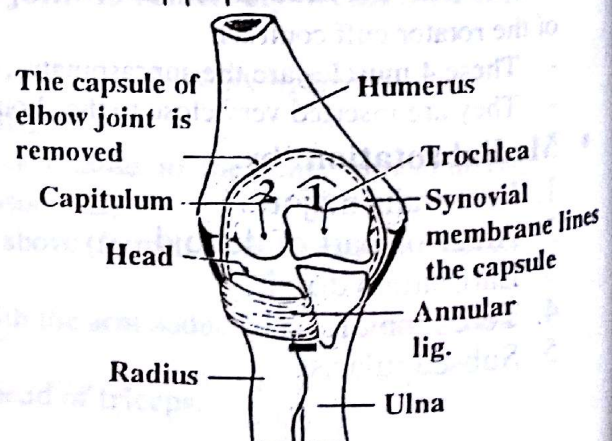
FIBROUS CAPSULE:

- **Proximal attachment:**
 - To the lower end of the humerus immediately above the coronoid, radial and olecranon fossae. (i.e. the 2 epicondyles are extracapsular).
- **Distal attachment:**
To the margins of the coronoid and olecranon processes as well as to the annular ligament which surrounds the head of the radius like a ring.



SYNOVIAL MEMBRANE:

- It lines the fibrous capsule and is reflected onto the **coronoid(1)**, **radial(2)** and olecranon fossae to cover the pads of fat filling these fossae.
- However, the **membrane stops at the margin of the articular surface** (like any synovial joint).

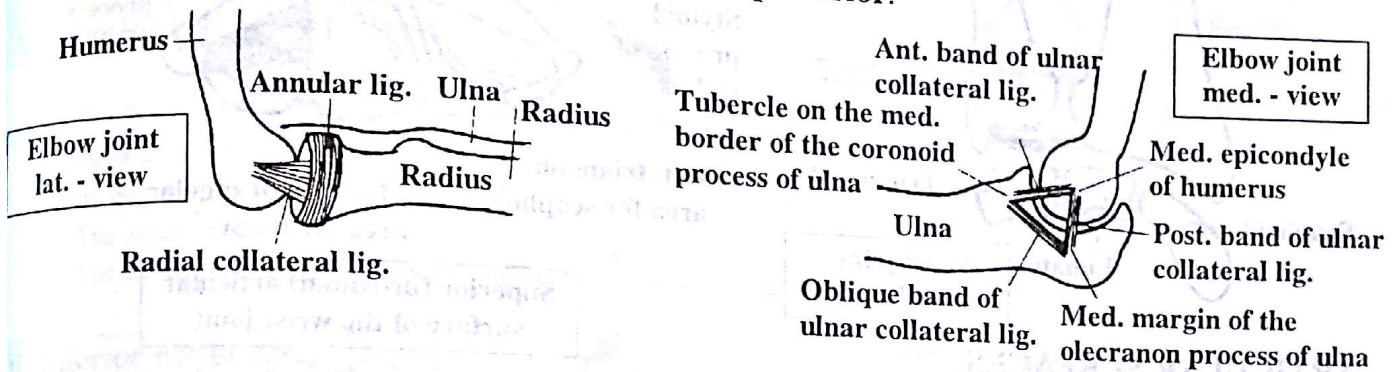


LIGAMENTS:

The elbow joint has 2 strong collateral ligaments (one on each side), as follows:

1. **Ulnar collateral ligament:**

It is composed of 2 main bands: **anterior** and **posterior**.



- **Anterior hand:** between the medial epicondyle and medial border of the coronoid process.

- **Posterior hand:** between the medial epicondyle and the olecranon.

N.B.: The oblique band of ulnar collateral ligament connects the anterior and posterior bands.

2. **Radial collateral ligament:**

Extends from the lateral epicondyle to the annular ligament which encircles the head of the radius.

MOVEMENTS:

As it is a hinge joint, the only movements are **flexion** and **extension** (uni-axial).

1. **Flexion:** by the brachialis and biceps, and assisted by brachioradialis.

2. **Extension:** by the triceps and assisted by the anconeus.

CARRYING ANGLE:

- It is the angle between the **arm** and the **extended supinated forearm**.

- It is open laterally and measures about 165° .

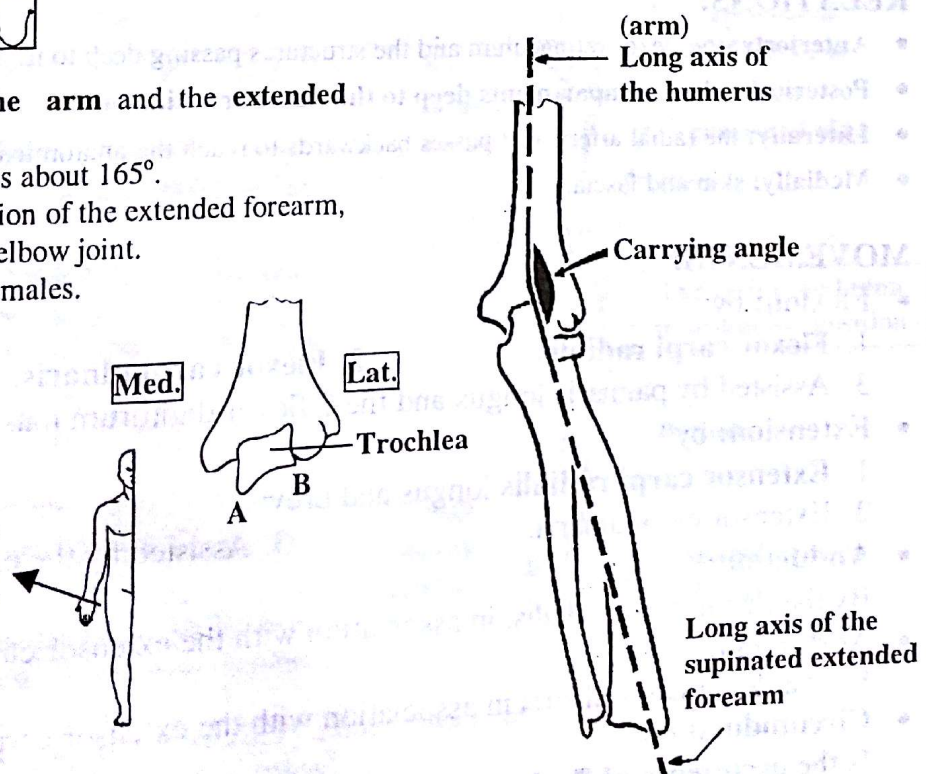
- The angle disappears in pronation of the extended forearm, as well as in full flexion of the elbow joint.

- The angle is more obvious in females.

- **This angle is caused by:**

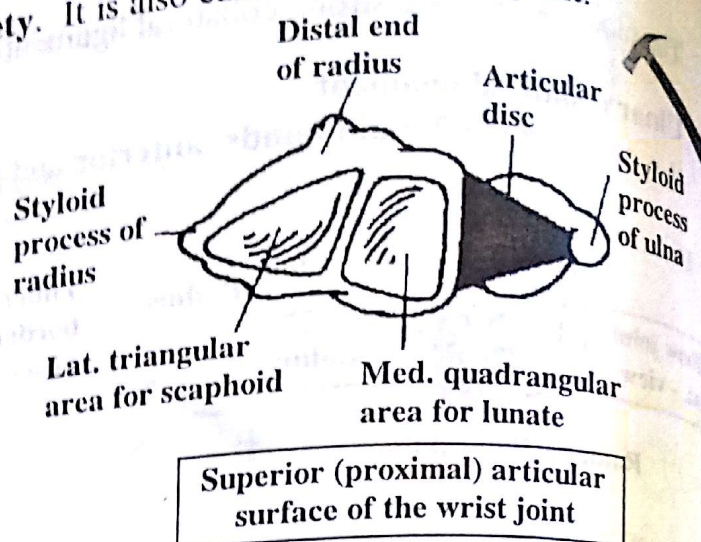
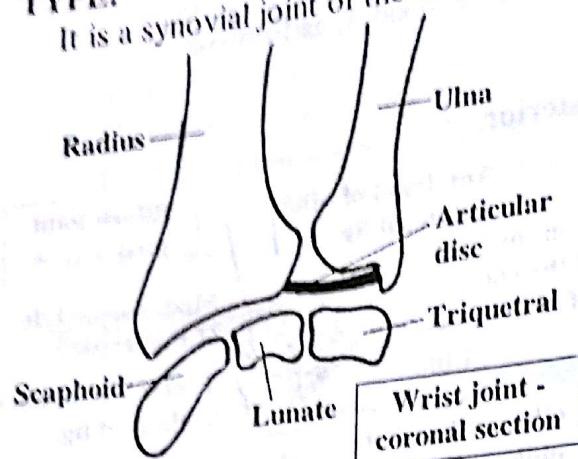
- Projection of the **medial edge of the trochlea (A)** more than the **lateral edge (B)** by about 5 mm.

- The presence of this angle leads to the presence of **gab** between the ulnar side of the extended and supinated forearm and the side of the thigh.



WRIST JOINT**TYPE:**

It is a synovial joint of the ellipsoid variety. It is also called radio carpal joint.

**ARTICULAR SURFACES:**

- **Proximal surface:** concave and formed by:

1. Lower end of the radius.

2. The articular disc (below the head of the ulna). *So the ulna do not share in elbow joint.*

- **Distal surface:** convex and formed by:

1. Scaphoid.

2. Lunate.

3. Triquetral.

FIBROUS CAPSULE:

It is attached to the margins of the articular surfaces, and is lined with the synovial membrane.

LIGAMENTS:

1. Anterior radio carpal ligament: anteriorly.
2. Posterior radio carpal ligament: posteriorly.
3. Radial collateral ligament: from the styloid process of the radius to the scaphoid bone (laterally).
4. Ulnar collateral ligament: from the styloid process of the ulna to the triquetral and pisiform bones (medially).

RELATIONS:

- Anteriorly: the flexor retinaculum and the structures passing deep to it.
- Posteriorly: the 6 compartments deep to the extensor retinaculum.
- Laterally: the radial artery as it passes backwards to reach the anatomical snuff-box.
- Medially: skin and fascia.

MOVEMENTS:

- **Flexion:** by:

1. Flexor carpi radialis.

2. Flexor carpi ulnaris.

3. Assisted by palmaris longus and the 2 flexor digitorum muscle - (superficialis & profundus).

- **Extension:** by:

1. Extensor carpi radialis longus and brevis.

2. Extensor carpi ulnaris.

3. Assisted by the extensor digitorum.

- **Abduction:**

By the flexor carpi radialis, in association with the extensor carpi radialis longus and brevis.

- **Adduction:**

By the flexor carpi ulnaris in association with the extensor carpi ulnaris.

- **Circumduction:**

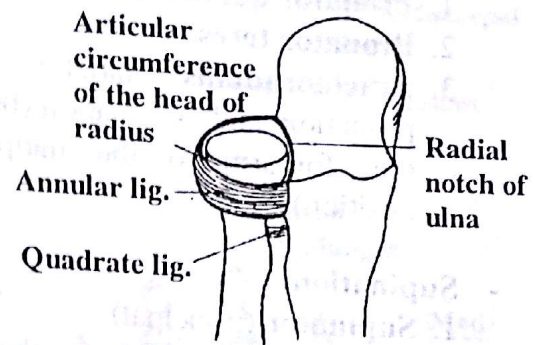
Is the occurrence of **flexion, abduction, extension and adduction** in succession.

RADIO-ULNAR JOINTS

These are the joints (superior and inferior) between the radius and ulna at which pronation and supination take place.

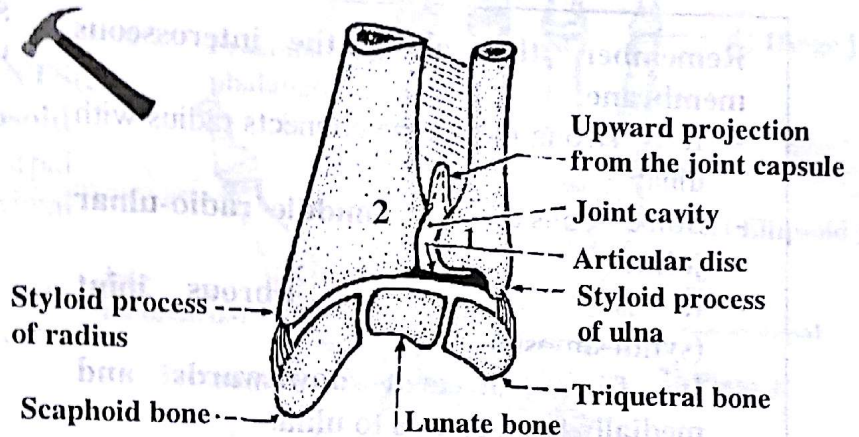
A. Superior radio-ulnar joint:

- It is a **synovial joint of the pivot type**, between the head of the radius and radial notch of the ulna.
- The head is kept in place by the annular ligament.
- The cavity of the joint is continuous with the cavity of the elbow joint.



B. Inferior radio-ulnar joint:

- It is a **synovial joint of the pivot type** (as the superior), between the head of the ulna(1) and ulnar notch of the lower end of radius(2).
- The 2 articular parts are held together by the articular disc which is a triangular plate of fibrocartilage.
- The disc separates the head of the ulna from the triquetral and medial part of the lunate bone especially in adduction of the wrist.



PRONATION AND SUPINATION:

- The movements of pronation and supination occur between the radius and ulna at the superior and inferior radio-ulnar joints.

- **In pronation:** the hand rotates medially, so that the palm faces posteriorly and the thumb lies on the medial side.

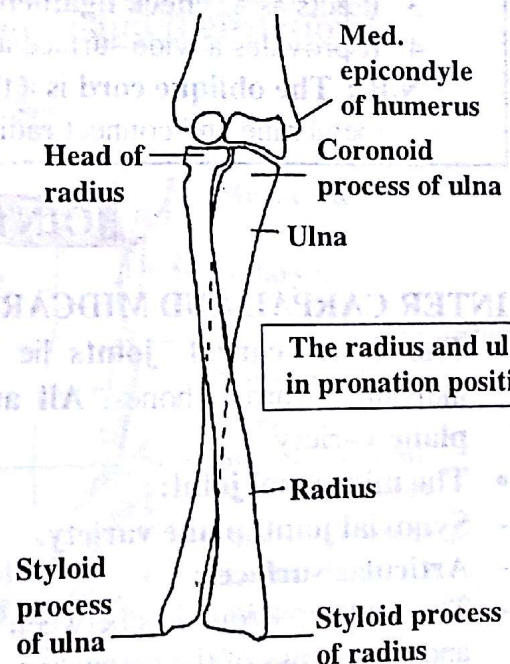
The head of the radius rotates within the annular ligament and its lower end rotates around the head of the ulna. As a result, the radius crosses obliquely in front of the ulna which is kept almost stationary.

The radius carries the hand with the palm directed backwards.

- **In supination:** the hand rotates laterally, so that the palm faces anteriorly and the thumb lies on the lateral side.

The radius lies parallel to the ulna, and the palm of the hand is directed forwards. Supination is more powerful than pronation.

- The axis of pronation and supination is represented by a line drawn from the center of the head of radius (above), to the center of the head of ulna (below).



The radius and ulna in pronation position

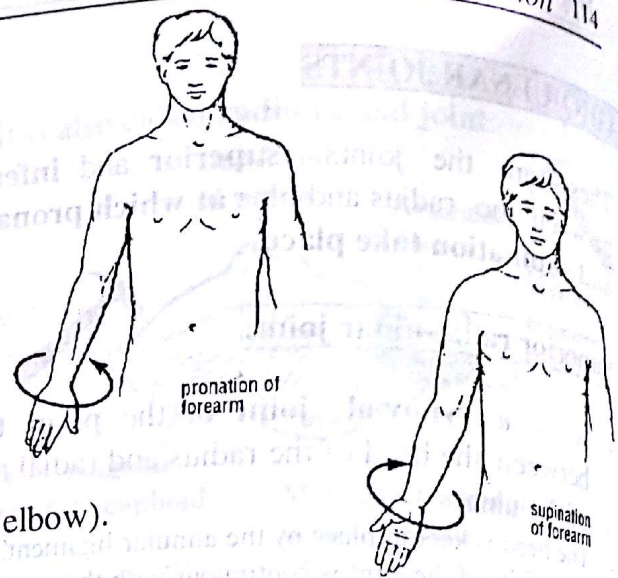
• Muscles producing the movements:

- Pronation:

1. Pronator quadratus.
2. Pronator teres.
3. Brachioradialis initiates both pronation and supination (brings the forearm to the midprone position).

- Supination:

1. Supinator (principal).
2. Biceps brachii (supinates the flexed elbow).



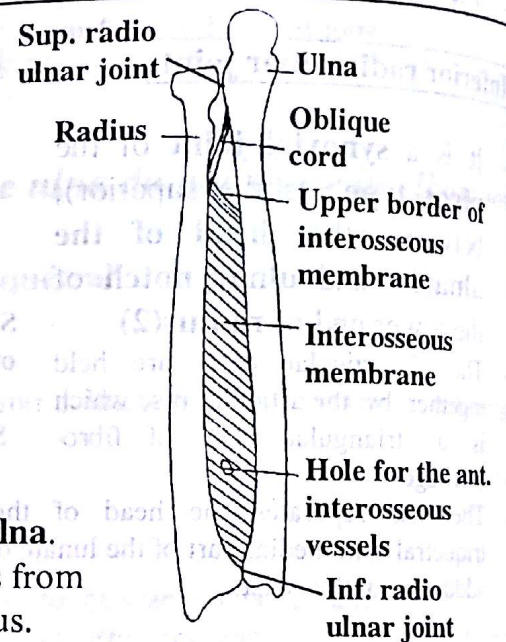
Remember that about the interosseous membrane:

- It is strong membrane connects radius with ulna.
- Some consider it as middle radio-ulnar joint.
- It is considered as fibrous joint (syndesimosis).
- Its fibers directed downwards and medially from radius to ulna.

• Functions of the interosseous membrane:

1. It connects the moving radius to the fixed ulna.
2. It transmits the forces applied to the radius from the hand towards ulna & hence to the humerus.
3. It acts as a "check ligament" preventing upward dislocation of radius.
4. It provides a wide surface area for muscle attachment.

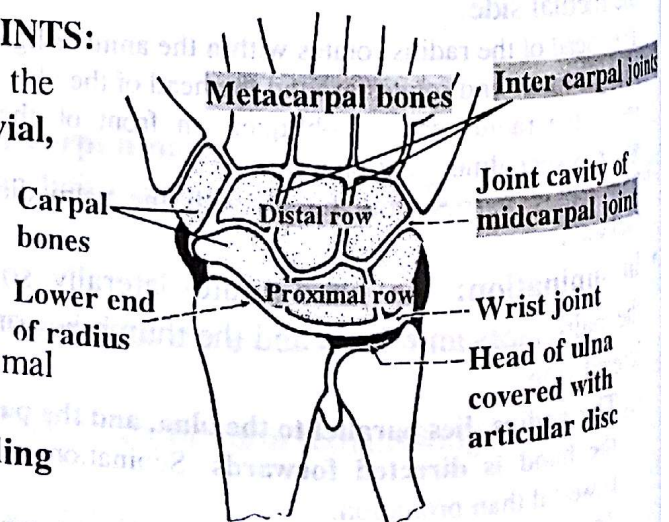
N.B.: The oblique cord is a thick cord has an opposite direction to the interosseous membrane and connect radius with ulna also.



JOINTS OF THE HAND

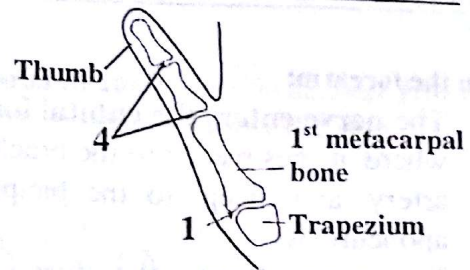
INTER CARPAL AND MIDCARPAL JOINTS:

- The inter carpal joints lie between the individual carpal bones. All are synovial, plane variety.
- The midcarpal joint:
 - Synovial joint, plane variety.
 - Articular surfaces:
 - The midcarpal joint lies between the proximal and distal rows of the carpal bones.
 - Movements at midcarpal joint: sliding (gliding) movement.
 - This joint has greater ranges of gliding movement during flexion and abduction, of the wrist joint.

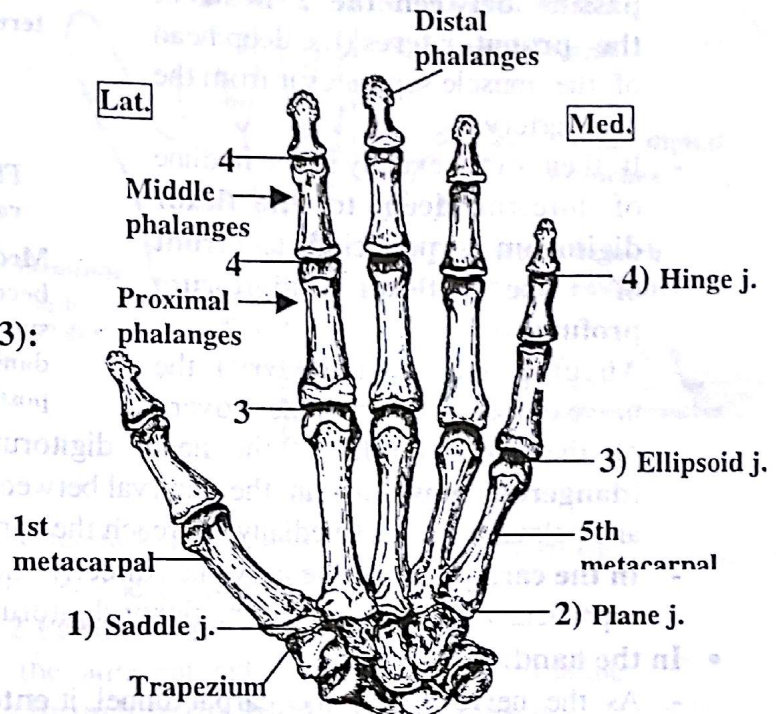


CARPO-METACARPAL JOINTS:

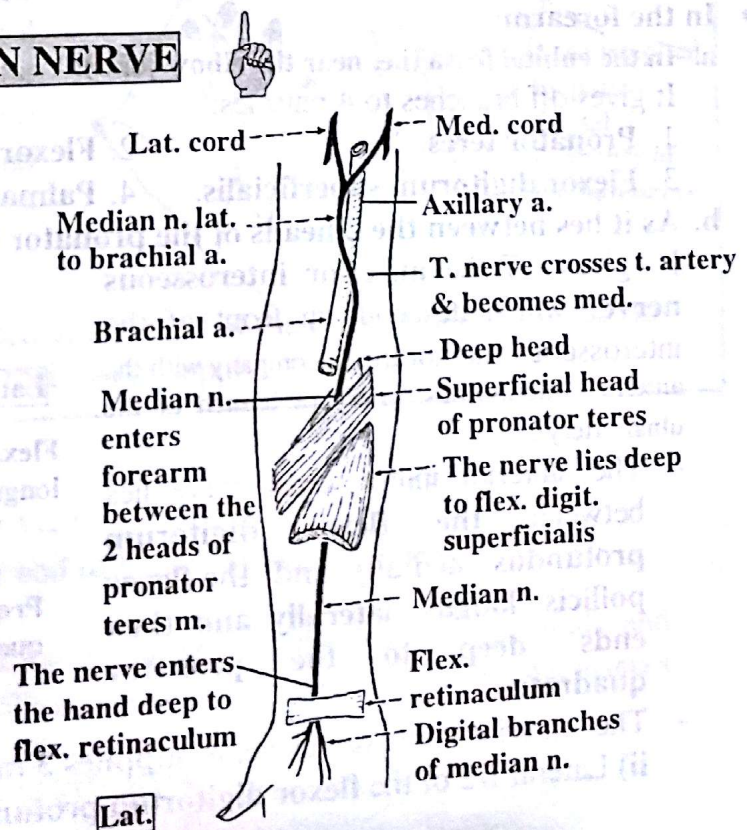
- **Carpometacarpal joint of thumb(1):**
It is a **synovial joint** of the **saddle variety**.
Its surface is **concavo-convex** between the **base of the 1st metacarpal bone** and the **trapezium**.
The movements which take place at this joint are: **adduction, abduction, flexion, extension** and some **rotation (opposition)**.
- **Carpometacarpal joint of other fingers(2):**
These are **synovial joints** of the **plane variety** at which **gliding movements** occur.

**METACARPO-PHALANGEAL JOINTS(3):**

- These are **synovial joints** of the **ellipsoid variety**, between the **heads of metacarpal bones** and the **bases of the proximal phalanges**.
The movements which occur at this joint are: **flexion, extension, adduction and abduction**.
- **Inter-phalangeal joints(4):**
These are **synovial joints** of the **hinge variety**, at which only **flexion and extension** take place.

**Summary for the 3 main nerves in the upper limb and their lesions****MEDIAN NERVE****COURSE AND RELATIONS:**

- **In the axilla and arm:**
 - It arises in the axilla by 2 roots: a **medial root (C.8 T.1)** from the medial cord and a **lateral root (C. 5,6,7)** from the lateral cord of the brachial plexus.
 - The nerve descends **lateral to 3rd part of axillary** and the upper part of the **brachial arteries**.
 - The nerve then **crosses in front of the brachial artery** to run along its medial side.
 - This crossing takes place **at the level of insertion of the coracobrachialis**.



- In the forearm:

- The nerve enters the cubital fossa where it lies medial to the brachial artery and deep to the bicipital aponeurosis.

- The nerve leaves the fossa by passing between the 2 heads of the pronator teres (the deep head of the muscle separates it from the ulnar artery).

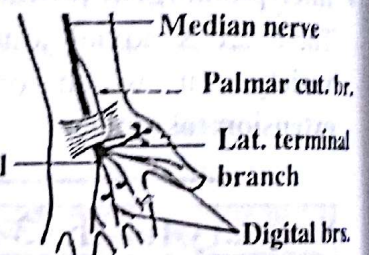
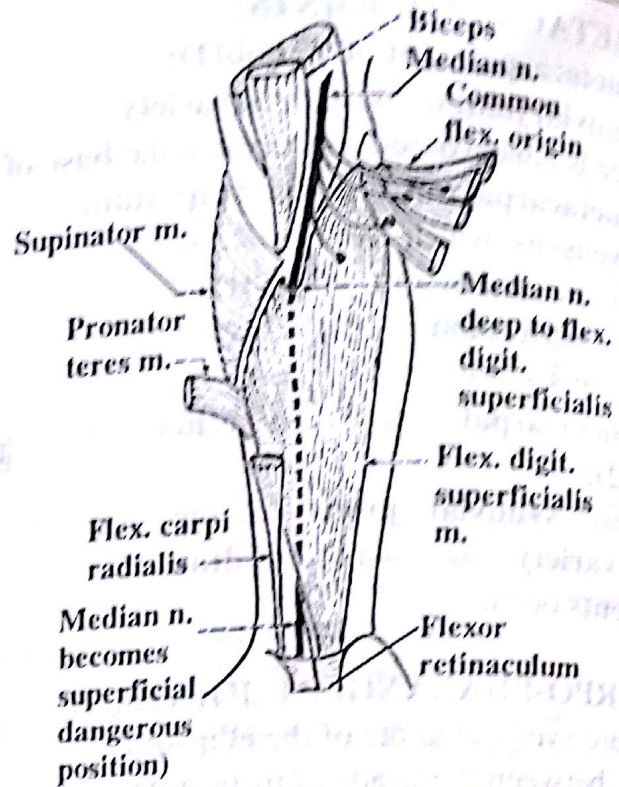
- It then runs exactly in the midline of forearm deep to the flexor digitorum superficialis and front of the flexor digitorum profundus.

- About 5 cm above the wrist, the nerve comes out from under cover of the lateral border of the flexor digitorum superficialis to lie superficially (dangerous position) in the interval between the flexor carpi radialis (laterally) and palmaris longus (medially) to reach the carpal tunnel.

- In the carpal tunnel the nerve lies directly under cover of the flexor retinaculum, superficial to the tendons of the flexor digitorum superficialis.

- In the hand:

- As the nerve leaves the carpal tunnel, it enters the palm of the hand where it divides into lateral and medial terminal branches, each of which gives off palmar digital branches.



BRANCHES:

- In the axilla and arm: No branches.

- In the forearm:

- a. In the cubital fossa (i.e. near the elbow joint):

It gives off branches to 4 muscles:

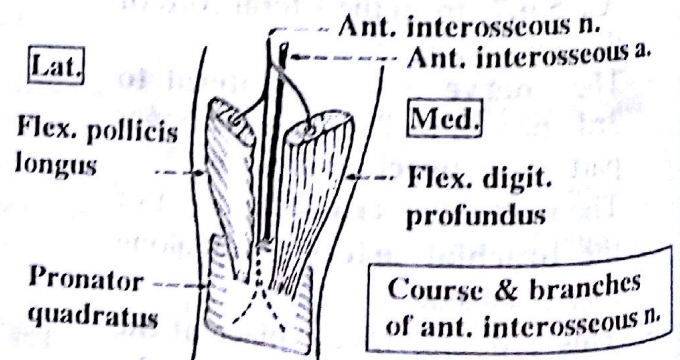
1. Pronator teres.
2. Flexor carpi radialis.
3. Flexor digitorum superficialis.
4. Palmaris longus.

- b. As it lies between the 2 heads of the pronator teres:

It gives off the anterior interosseous nerve which descends in front of the interosseous membrane in company with the anterior interosseous artery (a branch of the ulnar artery).

- The anterior interosseous nerve lies between the flexor digitorum profundus medially and the flexor pollicis longus laterally and then ends deep to the pronator quadratus.

- The anterior interosseous nerve supplies 3 muscles: i) Flexor pollicis longus. ii) Lateral 1/2 of the flexor digitorum profundus. iii) Pronator quadratus.



c. **About 5 cm above the flexor retinaculum:**

- The **median nerve** gives off the **palmar cutaneous branch**. (refer to fig. page 116)
- This branch descends in front of the flexor retinaculum to supply the skin of the **lateral 2/3 of the palm (but not the digits)**.

• **In palm of the hand:**

Immediately distal to the flexor retinaculum the median nerve divides into lateral and medial terminal branches.

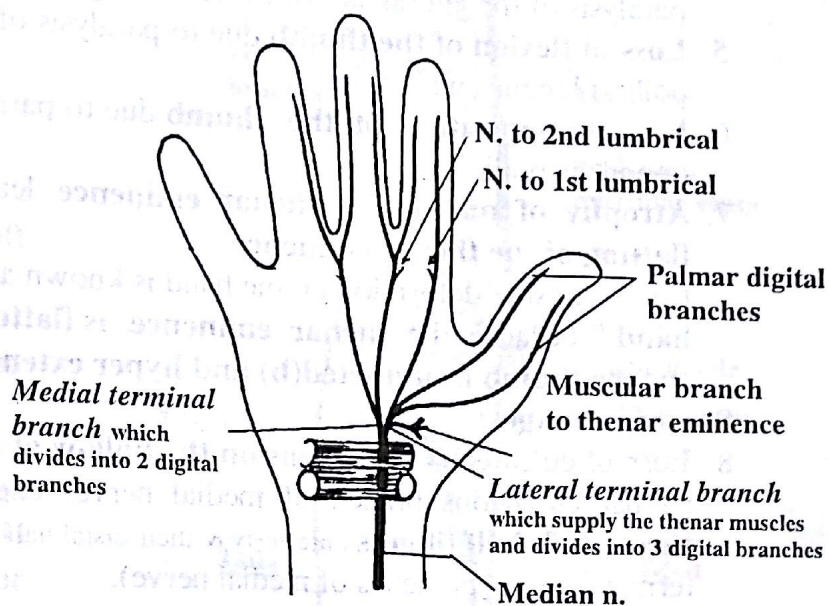
a. **Lateral terminal branch:** gives off:

1. A short thick **muscular branch** that runs laterally just distal to the flexor retinaculum to **supply the 3 muscles of the thenar eminence** (flexor pollicis brevis, abductor pollicis brevis and opponens pollicis).

2. **3 Palmar digital branches:** 2 to the thumb and one to the radial side of the index finger. The latter gives a branch to the **1st lumbrical muscle**.

b. **Medial terminal branch:** gives off: **2 Palmar digital branches:**

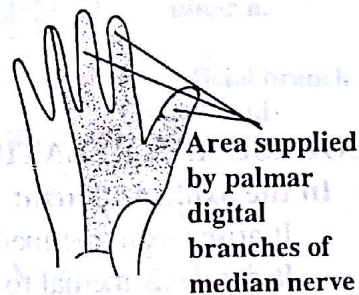
- **The 1st one:** divides to supply the adjacent sides of the index and middle fingers. During its course it gives a branch to the **2nd lumbrical muscle**.
- **The other branch:** divides to supply the adjacent sides of the middle & ring fingers.



N.B: The **palmar digital branches of median nerve** extend their distribution to the back of the lateral 3.5 fingers where they supply the skin of the dorsum of the distal phalanx of the thumb (nail bed), and both the distal and middle phalanges of the other 2.5 fingers.

This is because the nail beds originally were in the palmar surface of the hand of the embryo then it migrate to the dorsal surface accompanied by their nerve supply.

Median nerve extends to supply the nail beds



EFFECT OF INJURY:



• **Lesion above the elbow:**

It is produced by fracture of the lower end of humerus (supra condylar fracture).

Motor changes:

1. **Weakness of flexion of the wrist** due to paralysis of the flexor carpi radialis and palmaris longus & if flexion occurs, it is accompanied by adduction of the wrist due to intact flexor carpi ulnaris.
2. **Loss of pronation** due to paralysis of pronators.

3. Loss of flexion of the middle phalanges of all fingers due to paralysis of flexor digitorum superficialis.
 4. Loss of flexion of the terminal phalanges of the index and middle fingers due to paralysis of the lateral half of the flexor digitorum profundus.
 5. Loss of flexion of the thumb due to paralysis of flexors pollicis longus and brevis.
 6. Loss of opposition of the thumb due to paralysis of opponens pollicis.
 7. Atrophy of muscles of thenar eminence leading to flattening of the thenar eminence.
- Characteristic deformity in the hand is known as "Ape hand" because the thenar eminence is flattened (a) and the thumb is adducted (b) and hyper extended.



Sensory changes:

8. Loss of cutaneous sensations on the hollow of the palm (due to affection of the palmar cutaneous branch of medial nerve) and palmar surface of the lateral three and half fingers anteriorly & their distal half posteriorly (due to affection of the terminal digital branches of medial nerve).

• Lesion above the wrist:

It is produced by stab wound or broken glass which affects the nerve in the dangerous position (above the wrist).

1. Loss of opposition of the thumb due to paralysis of the opponens pollicis.
2. Atrophy of thenar muscles leading to flattening of the thenar eminence.

The characteristic deformity "Ape hand" is present.

3. Loss of cutaneous sensation on the palmar surfaces of the lateral three and half fingers.

ULNAR NERVE (C.8 T.1)



COURSE AND RELATIONS:

- In the axilla and arm:
 - It arises from the medial cord of the brachial plexus.
 - It descends medial to the artery till the insertion of coracobrachialis where it pierces the medial intermuscular septum.
 - It then descends downwards in the posterior compartment.
 - In company with the 2 ulnar collateral arteries to reach the back of the medial epicondyle.
- In the forearm:
 - It enters the forearm between the 2 heads of flexor carpi ulnaris and then descends along the medial side of forearm between the flexor carpi ulnaris (superficial) and the flexor digitorum profundus (deep).
 - Shortly above the wrist it comes out from under cover of the lateral border of the flexor carpi ulnaris and continues downwards superficial to the flexor retinaculum.
 - The ulnar nerve runs along the medial side of the artery in the lower 2/3 of forearm but is separated from it by a wide distance in the upper 1/3.

In the hand:

The nerve crosses superficial to the flexor retinaculum just lateral to the pisiform bone, where it divides into: a) **superficial** and b) **deep terminal branches**.

BRANCHES:

• In the axilla and arm: No branches.

• In the forearm:

2 **muscular** branches are given off near the elbow joint:

- Branch to **flexor carpi ulnaris**.
- Branch to medial 1/2 of the **flexor digitorum profundus**.

2 **cutaneous** branches:

i. **Palmar cutaneous branch**: arises about the middle of forearm and descends superficial to the **flexor retinaculum** to supply the medial 1/3 of the palm.

ii. **Dorsal cutaneous branch**: arises 5 cm above the wrist and curves backwards under cover of the flexor carpi ulnaris to supply the medial 1/3 of the back of the hand and back of the medial 1.5 fingers.

• In the hand:

a. **Superficial terminal branch**: gives off:

- 2 **palmar digital branches**: to the medial 1.5 fingers.
- A branch to the **palmaris brevis** muscle.

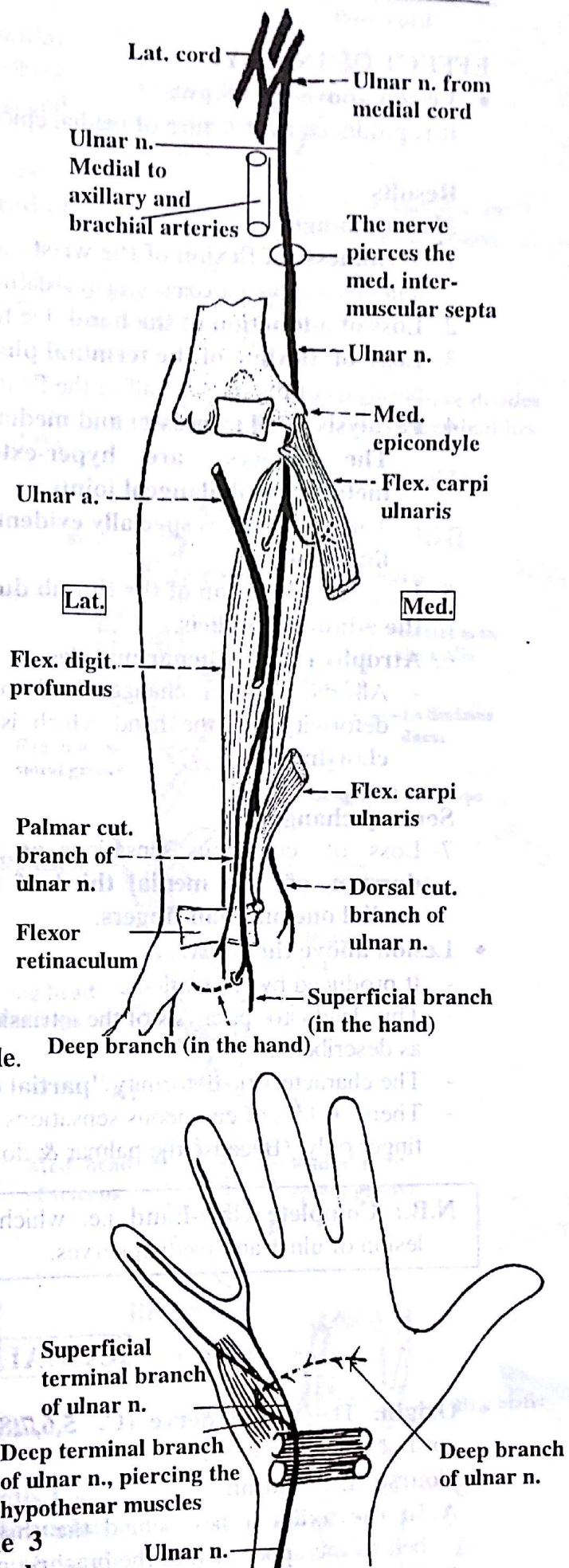
b. **Deep terminal branch**:

Passes deeply in company with the deep branch of the **ulnar artery**, and curves laterally deep to the long flexor tendons. Here, it lies in the **concavity of the deep palmar arch**.

It gives off muscular branches to many muscles:

- 3 muscles of the **hypothenar eminence** (abductor, flexor and opponens digiti minimi).
- 3rd and 4th **lumbricals**.
- All **interosseous muscles** (palmar and dorsal).
- **Adductor pollicis**.

N.B.: All muscles of the hand except the 3 thenar muscles and the lateral 2 lumbricals are supplied by the ulnar nerve (C. 8, T. 1).



EFFECT OF INJURY:

- **Lesion above the elbow:**
It is produced by: fracture of medial epicondyle of the humerus.

Results:

Motor changes:

1. **Weakness of flexion of the wrist** due to paralysis of the flexor carpi ulnaris, (and if flexion occur it is accompanied by abduction).
2. **Loss of adduction of the hand** due to paralysis of flexor carpi ulnaris.
3. **Loss of flexion of the terminal phalanges of the ring and little fingers** due to paralysis of the medial half of the flexor digitorum profundus.
4. **Paralysis of all interossei and medial two lumbricals.**
 - The fingers are hyper-extended at the metacarpo-phalangeal joints.
 - This deformity is specially evident in the ring and little fingers.
5. **Loss of adduction of the thumb** due to paralysis of the adductor pollicis.
6. **Atrophy of hypothenar muscles.**
 - All these motor changes lead to a characteristic deformity in the hand which is called "**partial claw-hand**".



Partial claw-hand

Sensory changes:

- 7- Loss of cutaneous sensations on the front and dorsum of the medial third of the hand and medial one and half fingers.



• Lesion above the wrist:

- It produced by cut wounds.
- This leads to paralysis of the intrinsic muscles of the hand as described above.
- The characteristic deformity "**partial claw-hand**" is present.
- There is loss of cutaneous sensations on the palmar surface of the medial one half finger only. (Because the palmar & dorsal cutaneous branches are intact).



N.B.: Complete claw-hand i.e. which affects all the fingers occurs in combined lesion of ulnar and median nerves.

RADIAL NERVE

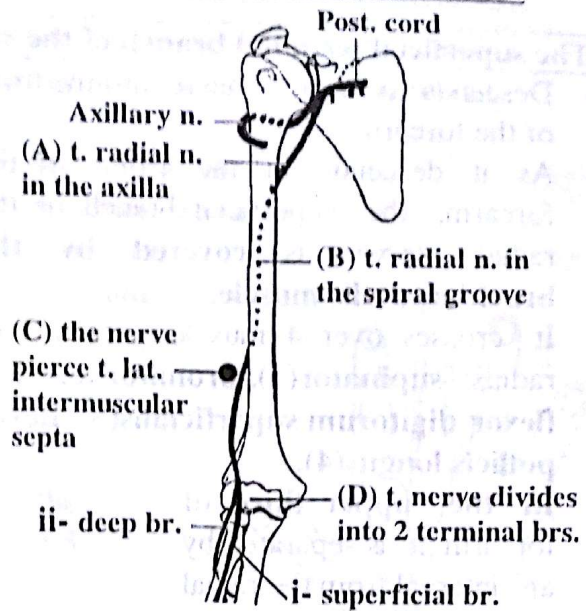


- **Origin:** The radial nerve (C. 5,6,7,8 & T. 1) is the continuation of the posterior cord of brachial plexus.
- **Course and relations:**
 - A. In the axilla it lies behind the third part of axillary artery; and then descends behind the upper inch of the brachial artery.
 - B. Then, it runs in the spiral groove (between the medial and lateral heads of triceps) deep to the lateral head of triceps.

C. Then, it pierces the lateral intermuscular septum and descends to the front of the elbow in the deep groove between the brachialis and brachioradialis.

D. In front of the lateral epicondyle and under cover of brachioradialis muscle, the radial nerve terminates by dividing into:

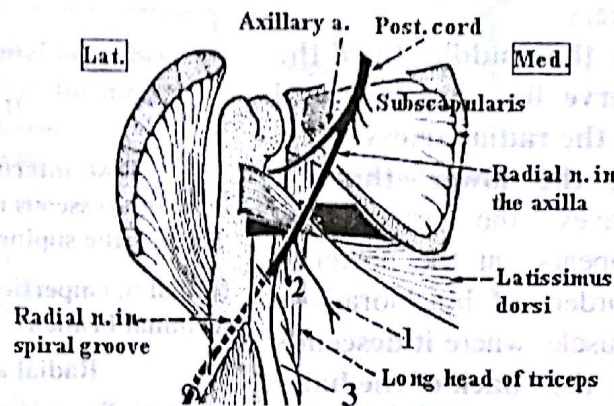
- a **superficial terminal branch** which is the continuation of radial nerve into the front of the forearm and
- a **deep terminal branch** (posterior interosseous nerve) which pierces the supinator muscle to reach the back of the forearm.



BRANCHES OF THE RADIAL NERVE:

A. In the axilla (3 branches):

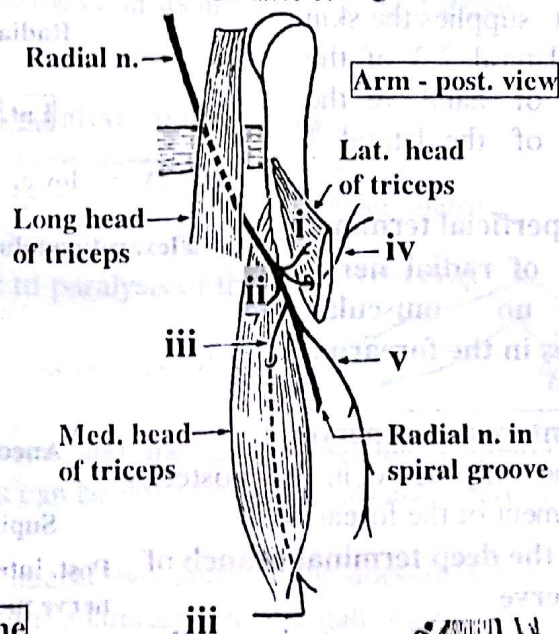
1. **Posterior cutaneous nerve of arm:** supplies the skin of the back of the arm.
2. **A branch to the long head of triceps.**
3. **A branch to the medial head of triceps.**



B. In the spiral groove (5 branches):

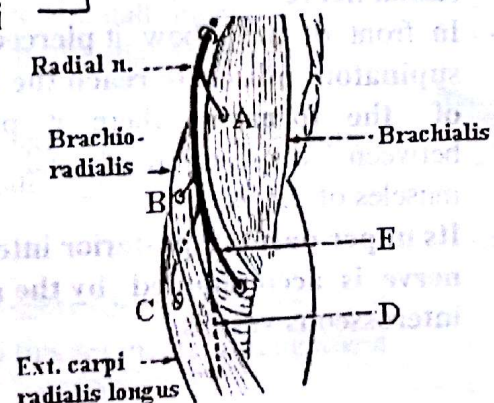
Branches to the lateral(i) & medial(ii) heads of the triceps.

- **Nerve to anconeus(iii):** a long and slender nerve which runs through the substance of the medial head of triceps.
- **Lower lateral cutaneous nerve of the arm(iv):** supplies the skin on the lower part of the lateral side of the arm.
- **Posterior cutaneous nerve of forearm(v):** descends to supply the back of forearm.



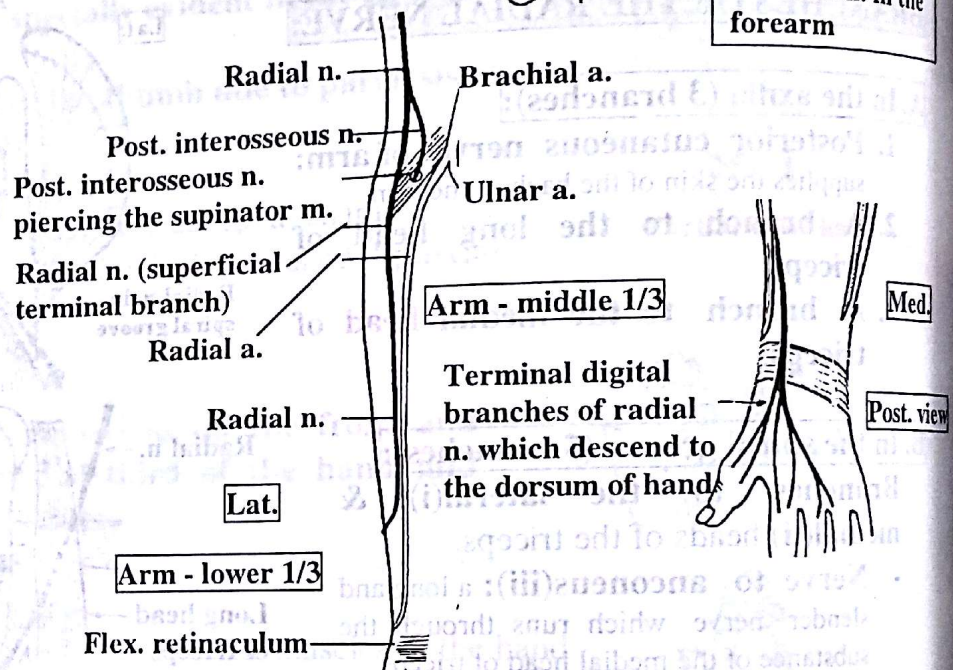
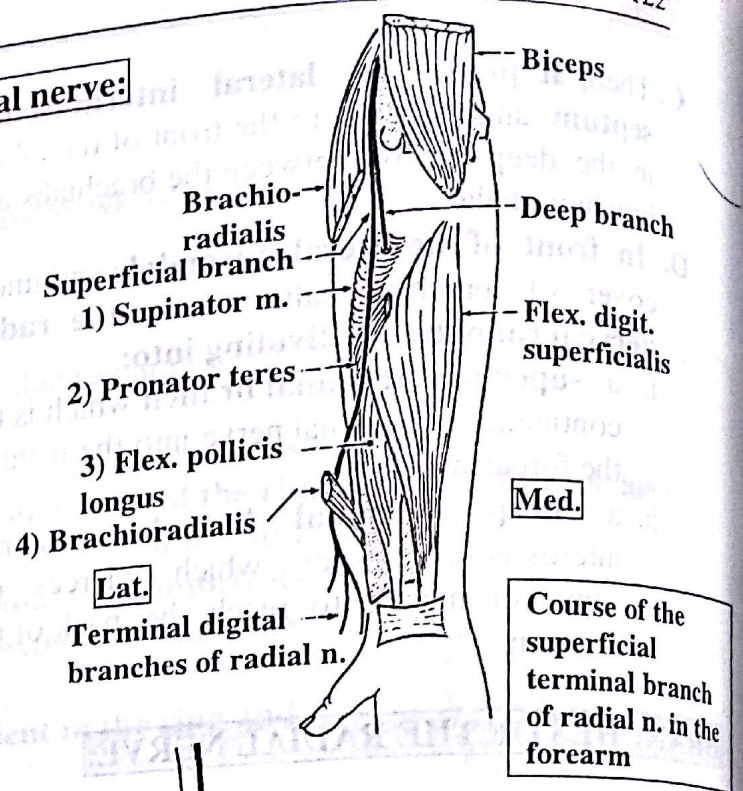
C. In the deep groove between the brachialis and brachioradialis (5 branches):

- Nerve to lateral fibers of the brachialis(A).
- Nerve to the brachioradialis(B).
- Nerve to the extensor carpi radialis longus(C).
- This is in addition to its 2 terminal branches: [(D)the superficial branch & (E)the deep branch which is called **posterior interosseous nerve**]



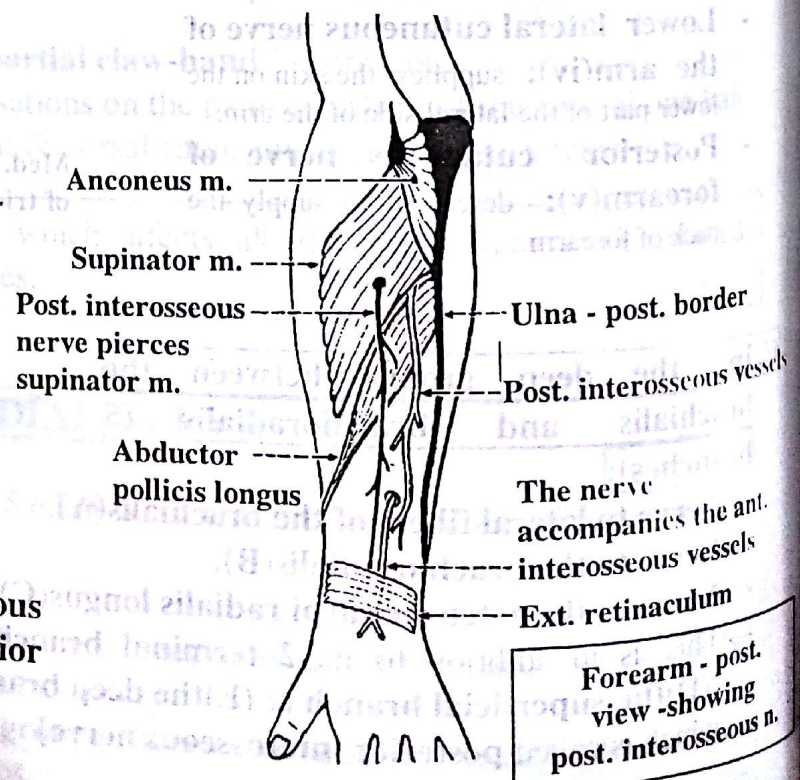
The superficial terminal branch of the radial nerve:

- Descends as a small nerve into the front of the forearm.
- As it descends in the front of the forearm, the superficial branch of the radial nerve is covered by the brachioradialis muscle.
- It crosses over 4 muscles attached to radius: supinator(1), pronator teres(2), flexor digitorum superficialis(3), flexor pollicis longus(4).
- In the upper third of forearm it is separated by an interval from the radial artery.
- In the middle third the nerve lies closely lateral to the radial artery.
- In the lower third, it leaves the artery and appears at the posterior border of brachioradialis muscle where it descends to the back of the hand where it supplies the skin on the lateral 2/3 of the dorsum of hand & the dorsum of the lateral 3 fingers.
- The superficial terminal branch of radial nerve gives no muscular branches in the forearm.



Posterior interosseous nerve:

- It is the only nerve in the posterior compartment of the forearm.
- This is the deep terminal branch of radial nerve.
- In front of the elbow it pierced the supinator muscle to reach the back of the forearm where it passes between the superficial and deep muscles of the back.
- Its upper part the posterior interosseous nerve is accompanied by the posterior interosseous vessels.



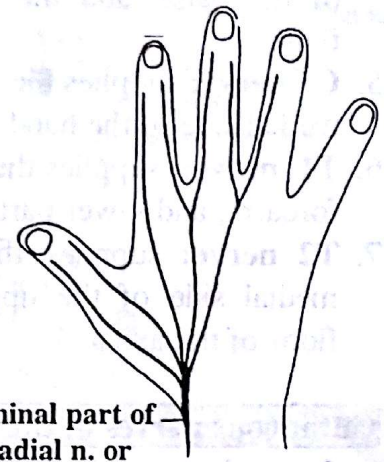
Its lower part is accompanied by the anterior interosseous vessels which accompany the nerve to the 4th compartment of the extensor retinaculum at the back of the wrist.

The posterior interosseous nerve supplies the following muscles:

1. Supinator.
2. Extensor carpi radialis brevis.
3. Extensor digitorum.
4. Extensor digiti minimi.
5. Extensor carpi ulnaris.
6. Abductor pollicis longus.
7. Extensor pollicis brevis.
8. Extensor pollicis longus.
9. Extensor indicis.

• **Dorsal digital branches:** these are 5 branches that arise from the superficial terminal branch.

- They supply the skin of the lateral 2/3 of the dorsum of the hand and dorsum of the lateral 3.5 fingers.



Terminal part of the radial n. or superficial terminal branch of

N.B.: It should be noted that the dorsal digital branches do not supply the distal phalanx of the thumb or the distal and middle phalanges of the index and middle fingers which are supplied instead by the median nerve.

INJURY OF RADIAL NERVE



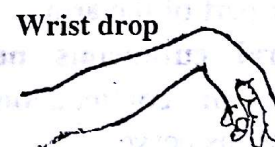
• **lesion in the axilla:**

It is caused by pressure of the nerve by:

- i. Crutch as in crutch palsy.
- ii. Back of the chair as in Saturday night palsy.

Motor changes:

1. **Loss of extension** of the above due to paralysis of the triceps.
- However, extension may occur passively by the effect of gravity.
2. **Loss of supination** of extended forearm due to paralysis of the supinator.
3. The characteristic deformity in the hand is known as "wrist drop" or "hand drop" due to paralysis of the carpal extensors.



There is also "finger drop" due to paralysis of the extensors of the fingers.

There is loss of extension of the wrist and metacarpo-phalangeal joints; but extension of the inter-phalangeal joints can be done by lumbricals and interossei.

Sensory changes:

4. **Loss of cutaneous sensations** on the lateral two-thirds of the dorsum of the hand and the dorsum of the proximal parts of the lateral three and half fingers.

• **Lesion in the forearm:** i.e. injury of the superficial branch of radial nerve.

It is caused by cut wounds of the back of wrist.

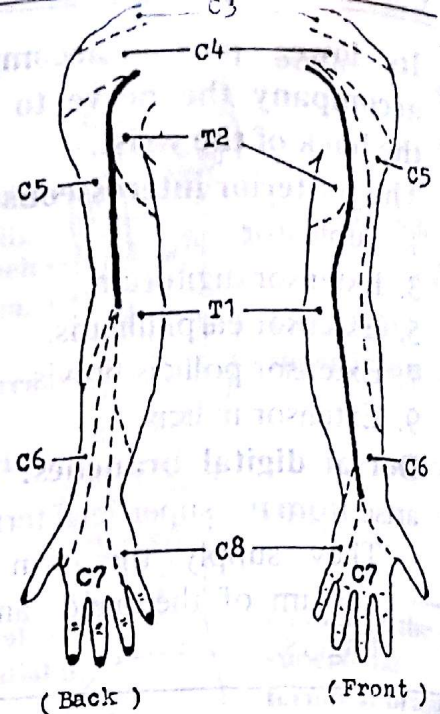
This leads only to loss of cutaneous sensations on the lateral part of the dorsum of the hand and the proximal parts of the lateral three and half fingers.

Segmental innervations of the skin of the upper limb

The skin of the upper limb is formed of series of segments (dermatomes) each of which is supplied by one spinal nerve (from C. 4 to T. 2) this segmental arrangement appears are follows:

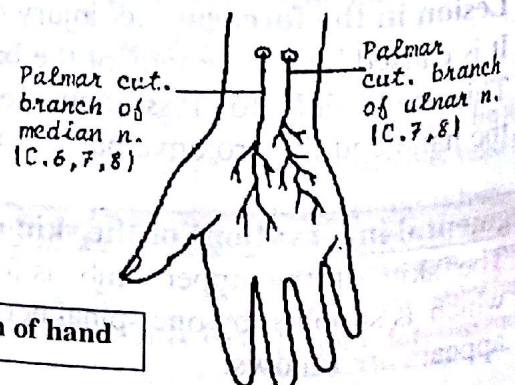
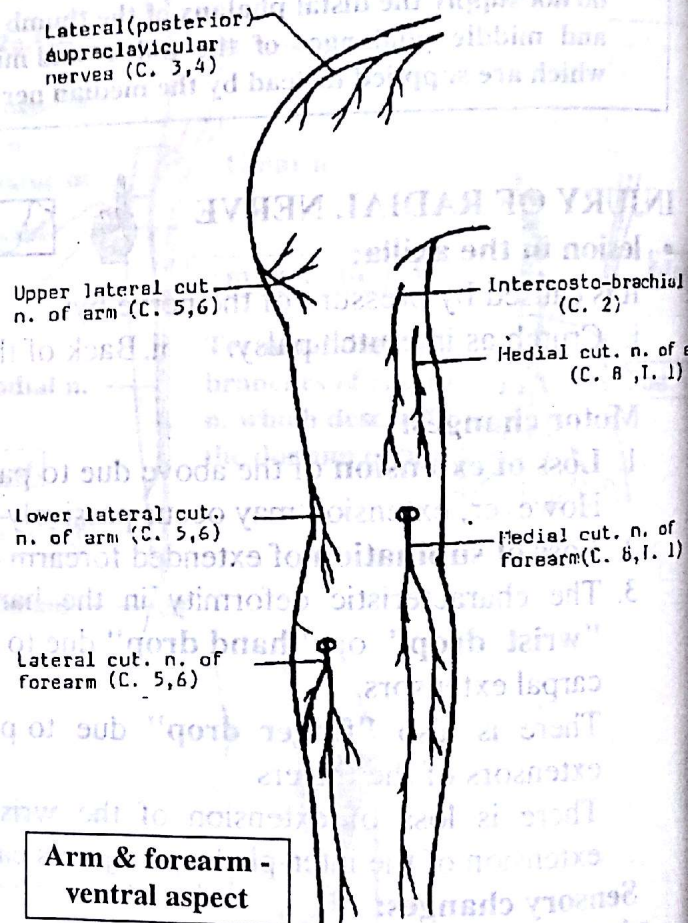
Upper Limb

1. **C4 nerve:** supplies the skin over the deltoid muscle.
2. **C5 nerve:** supplies the skin of the lateral side of the upper arm.
3. **C6 nerve:** supplies the skin of the lateral side of the forearm, and the skin of the thumb.
4. **C7 nerve:** supplies the skin of the palm and the back of the hand, and the skin of the 2nd, 3rd and 4th fingers.
5. **C8 nerve:** supplies the skin of the little finger and the medial side of the hand.
6. **T1 nerve:** supplies the skin of the medial side of the forearm, and lower part of the upper arm.
7. **T2 nerve:** supplies the skin of the upper part of the medial side of the upper arm, and the skin of the floor of the axilla.



Cutaneous nerves of the upper limb

- **Lateral supraclavicular nerves C. 3,4:** supply the skin over the upper half of the deltoid.
- **Upper lateral cutaneous nerve of the arm C. 5, 6:** continuation of the posterior branch of axillary nerve. It supplies the skin over the lower half of the deltoid.
- **Lower lateral cutaneous nerve of the arm C. 5, 6:** branch of the radial nerve in the spiral groove. It pierces the lateral head of triceps and supplies the skin on the lateral side of the lower part of the arm.
- **Lateral cutaneous nerve of forearm C. 5, 6:** continuation of the musculocutaneous nerve. It pierces the deep fascia on the lateral side of the biceps tendon. It divides into anterior and posterior branches which descend in the lateral side of the forearm.
- **Palmar cutaneous branch of median nerve C. 6, 7, 8:** arises one inch above the wrist and descends in front of the flexor retinaculum to supply the skin of the hollow of the palm.
- **Palmar cutaneous branch of ulnar nerve C. 7, 8:** arises in the forearm and descends in front of the flexor retinaculum to supply the medial third of the palm.



- **Palmar digital branches of median nerve C. 6, 7, 8:** are the terminal branches of the median nerve which supply the lateral three and half fingers.
- **Palmar digital branches of ulnar nerve C. 8 T. 1:** from the superficial terminal branch of the ulnar nerve. They supply the medial one and half fingers.
- **Terminal branches of radial nerve:** supply the lateral two-thirds of the dorsum of the hand and dorsum of the lateral three and half fingers.
- **Dorsal branch of ulnar nerve:** arises two inches above the wrist and passes backwards on the medial side of the wrist to supply the medial third of the dorsum of the hand and the dorsum of the medial one and half fingers.
N.B.: The skin on the dorsum of the terminal phalanges is supplied by the palmar digital nerves.
- **Posterior cutaneous nerve of forearm C. 5, 6, 7, 8:** branch of the radial nerve in the spiral groove. It pierces the lateral head of triceps and deep fascia and descends to supply the back of the forearm.
- **Medial cutaneous of forearm C. 8, T. 1:** branch of the medial cord of brachial plexus. It pierces the deep fascia in the middle of the arm and divides into anterior and posterior branches which descend into the medial side of the forearm.
- **Medial cutaneous nerve of arm C. 8, T. 1:** branch of the medial cord of brachial plexus. It pierces the deep fascia in the middle of the arm and supplies the skin on the lower part of the medial side of the arm.
- **Posterior cutaneous nerve of arm C. 5, 6, 7, 8:** branch of radial nerve in the axilla which descends to supply the back of the arm.
- **Intercosto-brachial nerve of arm C. 2:** is the lateral cutaneous branch of the second intercostal nerve. It supplies the skin of the axilla and upper part of the medial side of the arm.

